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WATER-POWER FOR ELECTRIC LIGHTING MACHINERY.

SIR WILLIAM THOMSON and Sir William Siemens called attention some years ago to the application of water-power for driving dynamo-electric machines, and the Falls of Niagara formed a basis on which some startling calculations were made. The latter gentleman, we believe, is understood to have said that the power of these falls, which is now running to waste, would some day be utilised for distribution throughout the State of New York. In this country several small experimental installations of electric lighting machinery and water-wheels or turbines have been successfully employed, but we are not aware of anything having been accomplished in any part of the globe which can compare in significance with the Brush Company's works at Rochester, N. Y. A description and illustration of this interesting enterprise will be found in our other columns, and it will doubtless command general attention. The Victor turbine is that in use, and its reputation, as will be seen, stands very high. Not having any extended practical experience with such machines, we cannot say how they compare for efficiency with turbines of English manufacture; but in any case, the success of these apparatus in America should induce some of our spirited engineers to make some efforts to introduce water-power for like purposes on a more extensive scale. The cost of horse-power produced by means of our steam-engines is considerable, and in places where water-wheels could be conveniently maintained, such expense would be avoided. Even if the water-power could not be utilised the whole year through, a combination of it and steam might be advantageously arranged.

THE DISTRIBUTION OF ELECTRICITY.

WE believe that we were the first to make any critical comments on the scheme proposed by the National Company for the distribution of electricity by secondary generators, for illuminating the Suez Canal by electricity. This called forth some remarks from M. Gaulard, the company's chief engineer, and joint designer with Mr. Gibbs of the induction coils used in the company's operations. Mr. Gisbert Kapp, about the same time, in a very sensible and matter-of-fact communication to our contemporary *Engineering*, shewed very forcibly the absurdity of M. Gaulard's arrangements, more particularly in those points relating to the electromotive force proposed, and the cost of the whole installation. An extract from Mr. Kapp's letter was published in our columns for August 18th. M. Gaulard's reply to this will also be found in our present issue. We have already expressed our opinion on the apparatus referred to, and therefore do not intend to open up the matter again, but we wish to draw attention to several points in connection with the controversy now going on in our contemporary. M. Gaulard does not attempt to argue with or refute Mr. Kapp's criticisms, and in this respect the gentleman last named is in a like position to that occupied by ourselves when in correspondence with M. Gaulard. The most interesting portion of the latter's communication is the fact that a machine has been devised to give currents of high tension. We presume that it is a 10,000 volt machine, as in the proposal to light the Suez Canal, four machines of that electromotive force are mentioned, making the total electromotive force of the primary current 40,000 volts. Another noteworthy fact is, that the Gaulard & Gibbs' system is about to be tested on the Metropolitan Railway stations, to the number of five. The machine to be employed is, we understand, an alternating current Gramme, and the lamps are to be of the incandescent type. We may therefore expect to see an installation of incandescence lighting, at a distance of several miles from the source of power, in working order by perhaps the middle or end of next month. It is then to be hoped, if, indeed, there is any likelihood of their eventual success at all, that tests may be made by electricians whose names are a sufficient guarantee of fairness and competence, so as to settle the question as to how far or in what direction these secondary generators can best be applied.

ELECTRO-MOTORS AND THEIR GOVERNMENT.

By Professors W. E. AYRTON, F.R.S., and JOHN PERRY, M.E.

(*Continued from p.* 144.)

From these numbers we have drawn curves shown in fig. 20, connecting $\phi + \gamma$ and $\frac{\text{E.M.F.}}{n}$ for each of the values of γ; and, finally, from these latter curves we find that the electromotive force due to the rotation of the coils in the armature field, as twisted by rotation and distorted by the iron of the field-magnets, is proportional to

$$(1 + 0{\cdot}8 \cos.\ \gamma) \sin.\ 2\ (\phi + \tfrac{1}{2}\gamma) + 0{\cdot}5 \cos.\ 2\ \gamma \sin.\ 4\ (\phi + \tfrac{1}{2}\gamma) + 3 \sin.\ \gamma,$$

Or, finally, that the total electromotive force in a dynamo or motor due to all causes is

$$n f(n)\, w' \left[F \cos.\ (\phi - \gamma) \mp \frac{A}{4} \left\{ (1 + 0{\cdot}8 \cos.\ \gamma) \sin.\ 2\ (\phi + \tfrac{1}{2}\gamma) + 0{\cdot}5 \cos.\ 2\gamma \sin.\ 4\ (\phi + \tfrac{1}{2}\gamma) + 3 \sin.\ \gamma \right\} \right],$$

the negative sign being taken for a dynamo, and the positive sign for a motor. For the numbers 0·8 and 0·5 and 3 in this expression, literal co-efficients may be applied to express the general condition.

Now as to the scale of these diagrams, it will be seen from what has gone before that $\frac{1}{2}$ A is to be used to express the greatest number of lines of force passing through any part of the armature when ϕ equals 90° and γ equals 0°, and, according to our scale of measurement employed in the diagrams above, A equals 4.

This expression, although complicated in appearance,

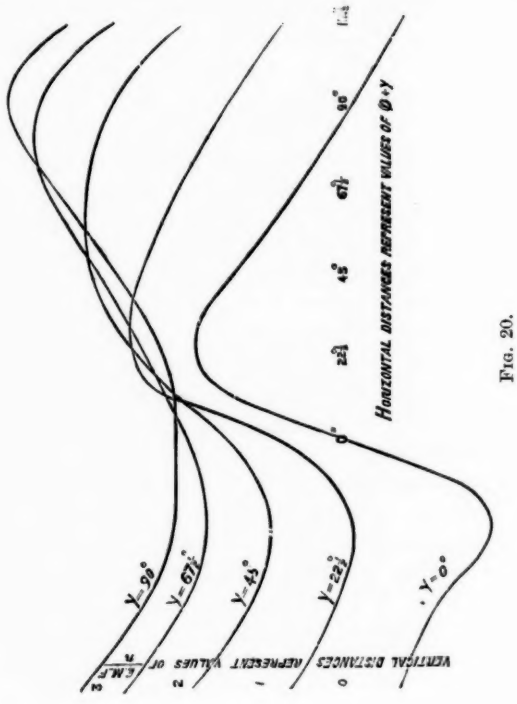


FIG. 20.

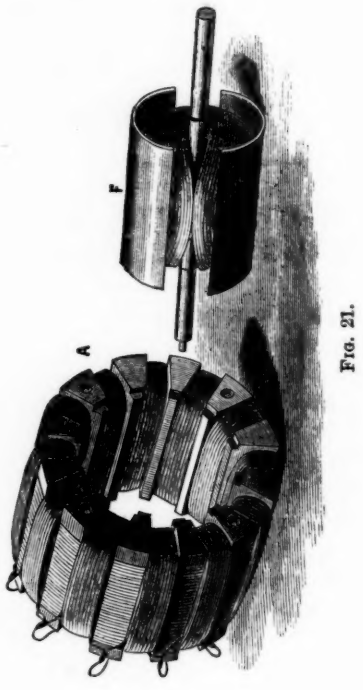


FIG. 21.

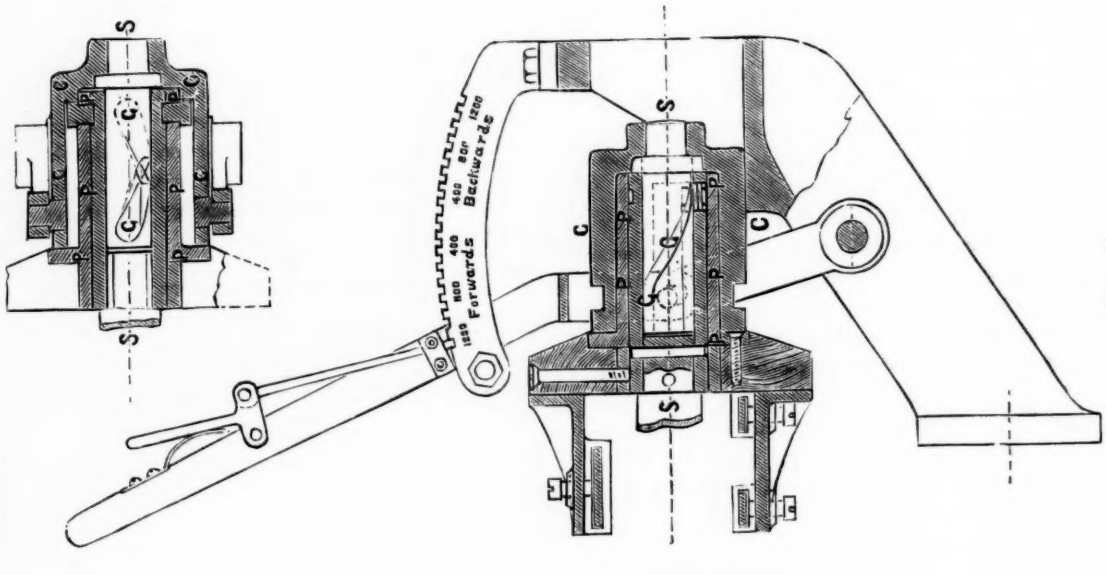


FIG. 22.

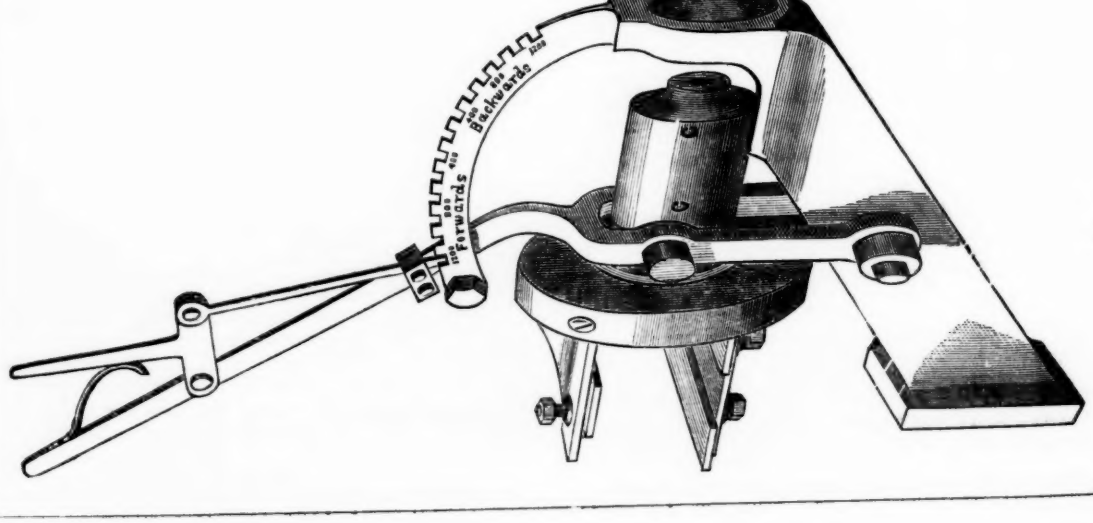


FIG. 23.

will be found very useful, since it takes into account all the disturbing action arising from the action of the iron of the rotating armature on the field due to the field-magnet, as well as the disturbing action of the iron of the field-magnet on the field set up by the current flowing round the rotating armature.

Best Relative Sizes of the Armature and Field-Magnet in a Dynamo and in a Motor.

Having arrived at the complete expression for the electromotive force in a dynamo or in a motor, we can now determine the proper relative proportions to give to the armature and field-magnet in each type of machine.

Let C and C′ be the currents passing round the field-magnet and armature respectively; then, since W and W′ are the numbers of convolutions on the field-magnet and armature,

$$\mathrm{F} : \mathrm{A} :: \frac{\mathrm{W\,C}}{1+s\,\mathrm{C}} : \frac{\mathrm{W'\,C'}}{1+s'\,\mathrm{C'}},$$

or if the iron cores of both the field-magnet and of the armature are far from saturation, then approximately

$$\mathrm{F} : \mathrm{A} :: \mathrm{W\,C} : \mathrm{W'\,C'}.$$

On referring back to the complete expression for the electromotive force in terms of n, ϕ, and γ, we see that we may roughly state the second part as W′ A sin. 2 $(\phi + \frac{1}{2}\gamma)$. Hence for a rough generalisation we may say that the electromotive force equals

$$n\,f(n)\ \mathrm{W'}\ (\mathrm{F}\cos.\ \phi \mp \mathrm{A}\sin.\ 2\,\phi),$$

and using the last proportion, the electromotive force, E, is proportional to

$$n\,f(n)\ \mathrm{W'}\ (\mathrm{W\,C}\cos.\ \phi \mp \mathrm{W'\,C'}\sin.\ 2\,\phi),$$

or the electrical power of the motor

$$\mathrm{C'\,E} \propto \mathrm{C'}\ n\,f(n)\ \mathrm{W'}\ (\mathrm{W\,C}\cos.\ \phi \mp \mathrm{W'\,C'}\sin.\ 2\,\phi).$$

Now, let us assume that the field-magnet and armature form together one continuous magnetic circuit, such as would be produced by an anchor ring all wound with coils of wire forming one or more distinct circuits, and traversed by currents all flowing in the same direction; then, if all parts of this magnetic circuit be equally heated, the magnetic moment of any part will be simply proportional to its length, whatever be the number of convolutions on this particular part or the currents flowing through them. Hence, if the field-magnet and armature in a dynamo or motor be equally heated by the currents passing round them, W, C and W′, C′ will be simply proportional to the lengths of the two portions into which we divide this closed magnetic circuit, and which are called respectively field-magnet and armature. If, therefore, L and l be the lengths of the magnetic circuit given up to the field-magnet and to the armature respectively, $\mathrm{L} + l =$ constant, say K, for a machine of a given type and weight. And since, as we have shewn,

$$\mathrm{C'\,E} \propto n\,f(n)\ (\mathrm{L}\,l\cos.\ \phi \mp l^2\sin.\ 2\,\phi),$$

we have to determine L, l, and ϕ, so that the latter expression may become as large as possible.

First, let us take the case of the negative sign, and let ϕ be positive (that is, the machine is a dynamo with a forward lead or a lead in the direction of rotation), then it will be found that the expression has a maximum for a very small value of l. For example, if ϕ is 30°, then the maximum is obtained when l equals $\frac{\mathrm{K}}{4}$. If ϕ is 45°, then l equal to $\frac{7}{34}\mathrm{K}$ makes the expression a maximum, &c. In other words, in a dynamo machine in which the brushes have, as is usually the case, a forward lead, the armature should be very small compared with the field-magnet, and should be the smaller the greater is the lead of the brushes.

Second, let us take the case of the positive sign, and let ϕ be positive, which corresponds with the case of a motor having a forward lead, then it will be found that, except for very small values of ϕ, the expression for the electromotive force has no maximum in the mathematical sense of the expression, but, instead, that as l increases the electromotive force continuously increases; hence, for any value of ϕ, such as 20°, l should be made as large as possible, to make the electromotive force as large as possible. In a motor, then, the armature should be by far the largest part of the machine.

If we assume merely that the weight of the machine is a constant, which is roughly the same thing as saying that the sum of the volumes of the field-magnet and armature is a constant, and if we assume that in making the field-magnet or armature larger or smaller in volume we increase the dimensions in all directions, so that the shorter part is thick and the long part thin, then we shall have some such relation as $\mathrm{A}^2 + \mathrm{F}^2 =$ a constant, say, K^2, if the volumes of the two component parts of the machine are considered as being proportional to the squares of their greatest magnetic strengths.

If, now, we take the case of a motor, that is, use the positive sign in the expression for the electromotive force, then we find that a maximum is obtained when

$$\mathrm{F}^2 = \tfrac{1}{10}\,\mathrm{K}^2,$$
$$\mathrm{A}^2 = \tfrac{9}{10}\,\mathrm{K}^2,$$
$$\text{and sin. } \phi = \tfrac{2}{3},$$
$$\text{or } \phi = 42°, \text{ approximately.}$$

Hence the armature must have 90 per cent. of the whole weight, and the field-magnets only 10 per cent.

On the other hand, if for the dynamo we take the same value of ϕ with the negative sign, then we find that the maximum electromotive force is obtained when it is the armature that has only about 10 per cent. of the whole weight, and the field-magnet 90.

We have every reason to believe, therefore, that an investigation concerning these relative sizes in a motor made to any design such as we can at present imagine, if soft iron is used in the field-magnet, must have the result that the armature part ought to form a much greater part of the whole weight than the field-magnet part, whereas in a dynamo machine it is the armature to which the very small weight is given.

When we consider, however, that the apparent resistance of a motor or dynamo due to self-induction is in proportion to the armature strength, we find that it is necessary to make the armature less in importance than might be assumed from the above investigation, and our own practical rule at present in the motors shown to the meeting consists in making the field-magnet about one quarter of the weight of the armature.

It must be remembered that it is not merely a condition for greatest steady power of a motor or dynamo which we have been looking for, but also a condition for greatest efficiency with a greatest steady power, because of two machines of the same power, when heated up to less than a destructive temperature, the larger will waste most power.

Now an armature, from its shape, is necessarily a weak magnet, while the field-magnet, from its shape, is a strong one; hence in our motors we have reversed the usual condition of things, and made the armature large and the field-magnet small, and from this we have been led, as will be seen from the accompanying figure (No. 21), to make the armature stationary and surrounding the field-magnet, instead of, as is usual, the field-magnet surrounding the armature.

Our small field-magnet, F, then carries the brushes and revolves inside the stationary armature, A, the coils of which, as is seen in figs. 1, 2, 3, and 24, are joined to the stationary commutator, C, C, which on some of our motors we make flat, to save both space and expense, while in others it is cylindrical, as this gives rise to less friction than the flat commutator. Wherever the brushes, B, happen to be at any particular moment, their two opposite magnetic poles are pro-

duced on the armature, or rather the poles are produced at two points in the armature, a little behind the brushes. As the brushes run round and round, so do these poles, and the brushes, which, be it remembered, are carried by the field-magnet, are so set that the magnetic poles in the armature are always a little way in front of the poles of the field-magnet. The latter, therefore, are perpetually running after the former, but never catching them.

We have spoken about the lead of the brushes, which we have seen is of great practical importance, since the amount of lead decides not merely which way the motor revolves, or whether it revolves at all, but also whether the fields due to the field-magnet and armature are added to one another or subtracted from one another in producing the resultant field. Although the fact that the direction of rotation could be reversed by a sufficient change in the lead was well known, the importance of varying the lead in motors for different speeds appears to be little attended to, since, as a rule, it is impossible in motors, from their construction, to make small changes in the lead. In our motors, on the other hands, the flat brush-holder can be revolved forwards or backwards by hand through any angle, so that any lead forwards or backwards can be given to the brushes for each speed, and in our larger motors, one of which is shown in fig. 3, the lead can be made anything we like simply by moving a handle, H, such as a locomotive engine-driver is accustomed to use for

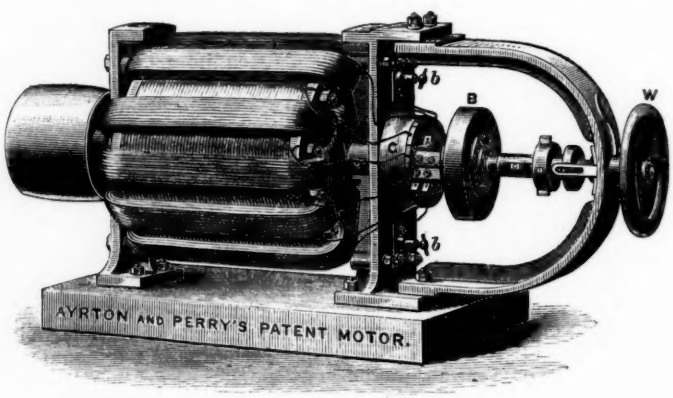


FIG. 24.

acting on the link-motion of his engine. Push the handle, shown enlarged in figs. 22 and 23, forwards, and the motor revolves rapidly in one direction; pull it backwards, and it revolves as rapidly in the other direction. Push it not so far forwards, and it does not revolve so fast in the first direction; pull it not so far backwards, and it does not revolve so fast backwards. In fact, by moving the handle forwards or backwards, any speed in either direction is obtainable. The action of our "lead adjuster" is as follows:—Attached to the rotating field-magnet is the spindle, S, S, which is itself attached to, and rotates with, the outer collar, C, C. On pushing the handle forwards or backwards, this collar is moved along the spindle, and the effect of this is to cause a pin to move along the groove, G, G, and so cause the inner collar, P, P, which usually rotates along with C, C and the field-magnet, to move a little forwards or backwards relatively to C, C. Now it is the collar, P, P, which is screwed to the brush-holder, hence we are able, even when the motor is running, to shift the brushes relatively to the field-magnet together with which they are rotating, and consequently to give any lead forwards or backwards we desire. In other cases we alter the lead by means of a wheel, W, and screw, as seen in fig. 24, and so get very easily a very accurate adjustment. A table of speeds can be engraved, showing the position the handle should be in for 500 revolutions a minute, or 700 revolutions a minute, &c.

(*To be continued.*)

THE ELECTRICAL TRANSMISSION AND STORAGE OF POWER.

By Dr. C. WILLIAM SIEMENS, F.R.S., M. Inst. C.E.

(*Continued from p.* 124.)

Amongst the numerous other applications of the electrical transmission of power, that to electrical railways, first exhibited by Dr. Werner Siemens at the Berlin Exhibition of 1879, has created more than ordinary public attention. In it the current produced by a dynamo machine, fixed at a convenient station and driven by a steam-engine or other motor, was conveyed to a dynamo placed upon the moving car, through a central rail supported upon insulating blocks of wood, the two working-rails serving to convey the return current. The line was 900 yards long, of 2-feet gauge, and the moving car served its purpose of carrying twenty visitors through the Exhibition each trip. The success of this experiment soon led to the laying of the Lichterfelde line, in which both rails were placed upon insulating sleepers, so that the one served for the conveyance of the current from the power station to the moving car, and the other for completing the return circuit. This line has a gauge of 3 feet 3 inches, is 2,500 yards in length, and is worked by two dynamo machines, developing an aggregate current of 9,000 Watts, equal to 12 H.P. It has now been in constant operation since the 16th of May, 1881, and has never failed in accomplishing its daily traffic. A line ½ a kilometre in length, but of 4 feet 8½ inches gauge, was established at Paris in connection with the Electric Exhibition of 1881. In this case, two suspended conductors in the form of hollow tubes with a longitudinal slit were adopted, the contact being made by metallic bolts drawn through these slit tubes, and connected with the dynamo machine on the moving car by copper ropes passing through the roof. On this line 95,000 passengers were conveyed within the short period of seven weeks. The Administration charged 25 centimes (2½d.), for the conveyance from end to end of the railway, and the amount was sufficient to pay all expenses. That, therefore, was a case of an electric railway that did pay.

An electric tramway, 6 miles in length, is nearly completed, connecting Portrush with Bush Mills, in the north of Ireland, in the installation of which I have been aided by Mr. Traill, as engineer of the company, and by Mr. Alexander Siemens, and Dr. E. Hopkinson, representing my firm. In this instance the two rails, 3 feet apart, are not insulated from the ground, but being joined electrically by means of copper staples, they form the return circuit, the current being conveyed to the car through a T-iron placed upon short standards, and insulated by means of insulite caps. Where a gap necessarily occurs, such as at a cross road, we simply stop the T-iron and com-

mence it again at the other side of the gap, connecting the two ends by means of an insulated conductor below ground. In order to span this gap we have two brushes attached to the car, one in front and the other towards the back of the car, and the gap being a little less than the distance between the two brushes, the one brush catches the opposite side before the other one leaves. Thus by a simple arrangement we get over the difficulty of crossing bye-roads. For the present the power is produced by a steam-engine at Portrush, giving motion to a shunt-wound dynamo of 15,000 Watts = 20 H.P., but arrangements are in progress to utilise a waterfall of ample power near Bush Mills, by means of three turbines of 40 H.P. each, now in course of erection. The working speed of this line is restricted by the Board of Trade to 10 miles an hour, which is readily obtained. With regard to this line, Dr. Edward Hopkinson, who is there, superintending the electrical arrangements, writes, "There is now no difficulty in starting the loaded car on the worst part of the hill, which a steam-engine frequently fails to do." This requires some explanation. You will observe in the plan and sections of the railway given in fig. 4, that there is a long and rather steep incline—1 in 38—

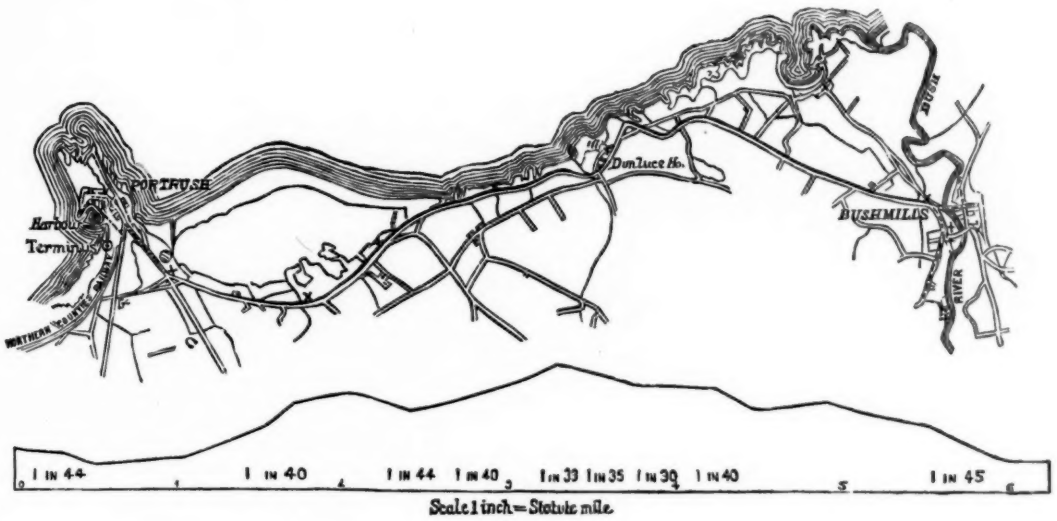


FIG. 4.

Portion of Line worked Electrically . 5 *Miles* 330 *Yards*
Passing Places X
Portion of Tramway in Towns not at present intended to be worked Electrically . . . . . ----------
Steam Engine and Carriage Sheds . O
Northern Counties Terminus . . . Θ
Position of Water Power . . . . . †
Conductor from Water Power to end of Line . . . . . 1600 *Yards*

two miles in length. There was some doubt in my mind whether, with the arrangements adopted, this incline could be worked satisfactorily; it now appears that it has been, and that the car is drawn up the incline without difficulty when fully loaded. I may, therefore, say that transmission or propulsion by electricity, even under adverse circumstances, is an accomplished fact. A further six miles of extension to Dervock will connect this railway with the railway system of the north of Ireland; we shall then have a length of twelve miles of line of the same gauge, and using the same carriages as those generally used there. Under these circumstances, it seems to me almost a pity that on the Embankment there should be made that series of unsightly and noisome ventilators to disembarrass the underground railway of steam and products of combustion, when it can be clearly demonstrated that electric propulsion would, for the underground railway, not only be the most agreeable, but also the cheapest mode of traction. I shall, at any rate, be most happy to afford to engineers every opportunity of studying this question.

The advantages of electrical propulsion are that the weight of the engine, so destructive of power and of the plant itself in starting and stopping, will be saved, and that perfect immunity from products of combustion will be ensured. The limited experience at Lichterfelde, at Paris, and with another electric line of 765 yards in length, and 2 feet 2 inches gauge, worked in connection with the Zaukerode Colliery since October, 1882, are extremely favourable to this mode of propulsion. I, however, do not advocate its prospective application in competition with the locomotive engine for main lines of railway.

For tramways within populous districts the insulated conductor involves a serious difficulty. It will be more advantageous under these circumstances to resort to secondary batteries, forming a store of electrical energy carried under the seats of the car itself, and working a dynamo machine connected with the moving wheels.

The secondary battery, to which I have already alluded in this lecture, is not an entirely new conception. The hydrogen gas battery suggested by Sir William Grove in 1841, realised in the most perfect manner the conception of storage, only that the power obtained from it was exceedingly slight. In working upon Sir William Grove's idea, 25 years ago I constructed a battery of considerable power in substituting porous carbon for platinum, impregnating the same with a precipitate of lead peroxidized by a charging current. At that time little practical importance attached, however, to the subject, and even when Planté, in 1860, produced his secondary battery, composed of lead plates peroxidized by a charging current, little more than scientific curiosity was excited. It is only since the dynamo machine has become an accomplished fact, that the importance of this mode of storing energy has become of practical importance, and great credit is due to Faure, to Sellon, and to Volckmar, for putting this valuable addition to practical science into available forms. A question of great interest in connection with the secondary battery has reference to its permanence. A fear has been expressed by many that local action would soon destroy the fabric of which it was composed, and that the active surfaces would become coated with sulphate of lead, preventing further action. It has, however, lately been proved in a paper read by Dr. Frankland before the Royal Society, corroborated by simultaneous in-

vestigations by Dr. Gladstone and Mr. Tribe, that the action of the secondary battery depends essentially upon the alternative composition and decomposition of sulphate of lead, which is therefore not an enemy of, but the best friend to, its continued action. The action of the battery depends simply upon the decomposition of the coating of sulphate of lead, so that, commencing with sulphate of lead on both surfaces, this is on the one hand changed into metallic lead, and on the other hand into peroxide; by the action of the battery in producing power it is changed back into its original condition; and there is no *à priori* reason why such a battery should not be available for use for a very long time. Of course you cannot expect to get quite as much of effect out of it as you put in. I am not prepared to say precisely what the loss is, but certainly it is not of such serious import as to prevent the practical use of these secondary batteries. As regards their application to tramways, their usefulness will extend to lines in the interior of towns, and to crossing parts of towns where it would be difficult to establish separate insulated conductors; in such applications the batteries may be charged occasionally by the dynamo on the car in running down hill, or they may be charged in running upon level ground from the dynamo at the power station. In like manner for boat propulsion, the secondary battery is the only available means; because we could never hope to attach a vessel permanently to a rope connected with the shore. The batteries, although heavy, may be made part of the keel-weight; and although neither with the railway nor with the boat should I expect long distances to be traversed with electricity as a motive power, for short distances, and under conditions where steam power is for various reasons not applicable, I believe we have in electric energy an efficient and practicable means of propulsion.

I had intended to say something on the subject of electrical units, and also of the principles involved in measuring currents; but this is a subject which Sir William Thomson will bring before you in a much more complete and exhaustive manner than I can hope to do. I hold, however, in order to know anything about a physical effect, you must be able to measure it, and it is therefore impossible to deal with electric quantities without at the same time looking round at the means at our hand for measuring and weighing, as it were, one effect against the other. The Electric Congress, which met in Paris in 1881, laid down certain general rules, and made certain determinate units for the use of the electrician—the Ohm, the Volt, the Ampère, the Coulomb, and the Farad. But there seemed to be a general want felt for a unit that would give us more directly the amount of work done by a given current; and last summer, in delivering my presidential address to the British Association, I ventured to propose two additional units—the Joule, representing the unit of heat or of work accomplished by a unit of current in a unit of resistance; and the Watt, the unit of power, or the Ampére into the Volt. This proposal, I am glad to find, has met with very general acceptance. We now measure the power of the dynamo machine in Watts; and the advantage of this measurement of Volt-Ampéres, or Watts, is, that it is the best expression of the power of a machine of given dimensions, which will be capable of producing the same Watt power, either of a high potential and small quantity when thin wire is used on its coils, or of low potential and larger quantity when thick wire is used. Seven hundred and forty-six such Watts are equal to 1 H.P.; therefore, if a machine was given to you of say 10,000 Watt power, you would know at once that it would take about 13 H.P. to drive it, to which you would have to add 10 per cent. for frictional losses. If we wished to know the effect from that machine, say in working incandescent lights, we may calculate that three Watts produce one candle of effect, whereas in the case of a powerful arc light, one Watt is capable of producing three-candle power.

I should have alluded to a number of instruments which have been lent me by the kindness of Professors Ayrton and Perry. They are machines for measuring the different electric quantities, the Volt, the Ampére, and the dynamic effect. I have here, also, an instrument kindly sent me by the Edison Company, which measures the electric quantity in Coulombs. It is based upon the principle of work done chemically. A given current produces an amount of chemical work, and by the amount of chemical work so produced in a branch circuit, the current that has flowed through is estimated. I have already alluded to the dynamometer I usually employ which measures the current in Ampéres. This dynamometer consists of one fixed coil surrounded by another coil of a single turn at right angles to the former, through both of which the current passes, so that there will be an attraction between the one wire and the coil of wires, which is proportionate to the square of the current passing; and by the aid of a table which I have here, I can interpret the deflection produced on the index in Ampéres. But we have lately improved upon this in a very simple manner, so as to get the reading at once in Ampére-Volts or Watts. The only difference between the two instruments is, that in the latter case the stationary coil consists of many convolutions, and is of very high resistance, and the single convolution of thick wire, suspended freely, is of very low resistance (see fig. 5). Now, when a current flows through a high resistance, we measure its potential, and when through a low resistance, its quantity, hence the mutual attraction between the two is no longer according to the square of the current, but as the energy of the current, and we get Volt-Ampéres of current, or Watts.

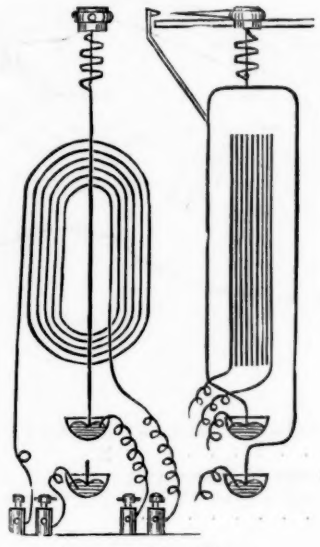


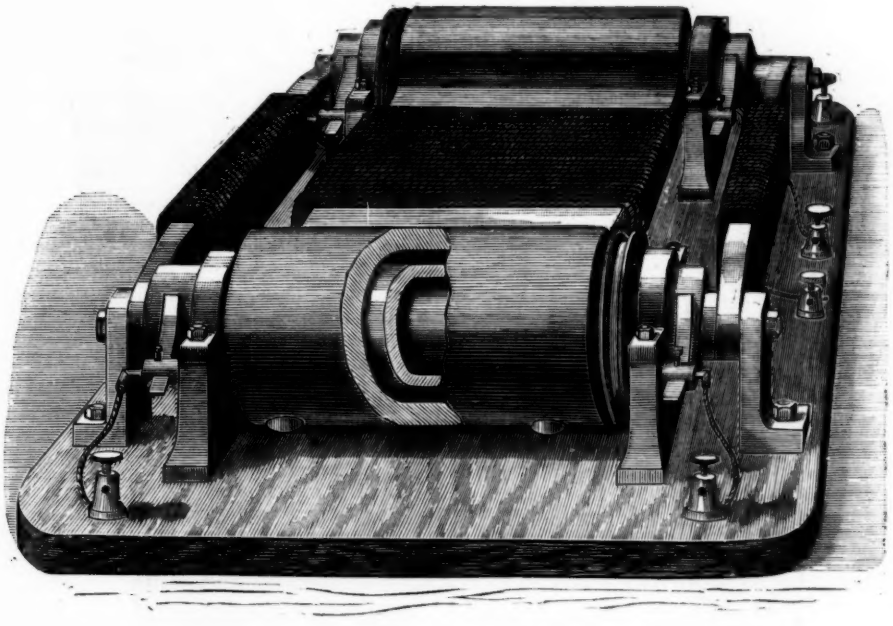
FIG. 5.—WATT METER.

In conclusion, I would only observe that I should have wished to have drawn attention to the various kinds of dynamo machines which have been developed by different inventors; but it would have been impossible to accomplish this in the space of time allowed me, and moreover, I think it better to deal with the principles involved in these machines than with those most important, yet practical and secondary, results obtained by modifications of the elements which are at the bottom of all of them. It is so far fortunate that all the essential principles involved in dynamo machines are public property, and there is a fair field for inventive faculty to develop those forms which are productive of maximum results with the least amount of inconvenience or expense. This is a matter that can only be decided by experience, and little would be gained by upholding one machine to the detriment of another. I hope, at any rate, I have succeeded in giving you a general outline of this most important question of the dynamo machine and the electric transmission of power.

NEW DYNAMO-ELECTRIC MACHINE.

THE engraving represents a dynamo-electric machine, whose armature has neither wire nor bars, and in which no commutator is required, as the current flowing from the machine is all in one direction. This machine is remarkable for its simplicity and its economy in the use of power. It delivers a current of very low electromotive force suitable for plating and for incandescent electric lighting. When used for the latter purpose, a small high tension machine may be employed to advantage to supply a current to the field-magnets.

The machine consists, says the *Scientific American*, of a field-magnet having hollow cylindrical polar extremities, in each of which a tubular armature revolves, the bearing of the armature being at the ends of the cylindrical poles of the field-magnet. An auxiliary field-magnet, composed of side bars and cylindrical pole extensions extending through the armature, axially completes the arrangement, and acting together with the outer magnet produces a strong magnetic field surrounding the armature on all sides. The current is conducted away from the ends of the armature by wires



connecting with the armature journals, and with springs bearing on the ends of the armature. The springs are applied to ensure a constant connection.

In operating the machine, the current from one armature may be used to excite the field-magnets, or the current from both armatures may be taken through the wire of the field-magnets, or, as stated above, the field-magnets may be excited by a small high tension dynamo, and the entire current of the armatures may be applied to outside work.

The current from this machine is uniform and continuous, and always in the same direction, so that there are no reversals or interruptions, and consequently no sparks.

This novel dynamo has been patented by Mr. A. Floyd Delafield, of Noroton, Conn.

Sixpenny Telegrams.—From calculations which have now been made, says the *Postal Telegraphic and Telephonic Gazette*, it is confidently predicted by the telegraphists of the Post-office that the cost of carrying out the sixpenny telegram system will not be far short of £1,000,000, or nearly twice the amount originally estimated.

THE BRUSH ELECTRIC LIGHT WORKS, ROCHESTER, N.Y.

THE following description of the power station for the Brush Electric Lighting Company, of Rochester, N.Y., is from the *Milling World* and the *Scientific American*. These works are located on the west bank of Genesee River, at what are styled "the Lower Falls," within the city of Rochester, N.Y., and they derive their motive power from the waters of that river. They are intended for generating electricity for lighting purposes in the city of Rochester and vicinity. They consist of a brick superstructural building or house, 100 feet long by 50 feet wide, and one story high, resting upon and supported by substantial substructural walls and piers of stone and brick, of various heights and forms, and substantially based upon prepared foundations at various levels in the solid rock.

Fig. 1 is a cross sectional elevation through the wheel and gear pit, as viewed from the north or down stream end. Fig. 2 is a longitudinal section from the bottom of the wheel pit upward, as viewed from the west or land side of the works.

The superstructure is spanned across its width at the base of the roof with nine trussed girders, which support the roof and the line shafting with its leading wooden rimmed band wheel, 5 feet diameter by 4 feet 8 inch face, and 18 pairs of fast and loose wood-rimmed pulleys, 42 inch diameter by 13 inch face each, making 360 revolutions per minute, and connecting by 12 inch belts, with 18 electro-dynamic machines arranged upon the floor near either side of the building, as shown in fig. 1, giving them 756 revolutions per minute, at an expense of 40 horse-power each, making a total of 720 horse-power, supporting 720 lights, equal to 40 lights per machine, or one light per horse-power. The magnitude of the lights is not stated. In fig. 2 is a side elevation of one of the machines. The fast and loose pulleys which drive the dynamos were furnished by the Taper Sleeve Pulley Works of Erie, Pa., and they are so constructed and arranged that by one single and gradual movement of a double-headed oscillating cam, in connection with a belt-shifter, the loose pulley, which hangs on a hollow independent bearing (not shown in the cut), concentric with and surrounding the shaft without contact therewith, is thrown into gear and set in motion, so that as the cam is continuously moved forward through the extent of its parallel arc, which holds the loose pulley in gear, the belt is shifted on to

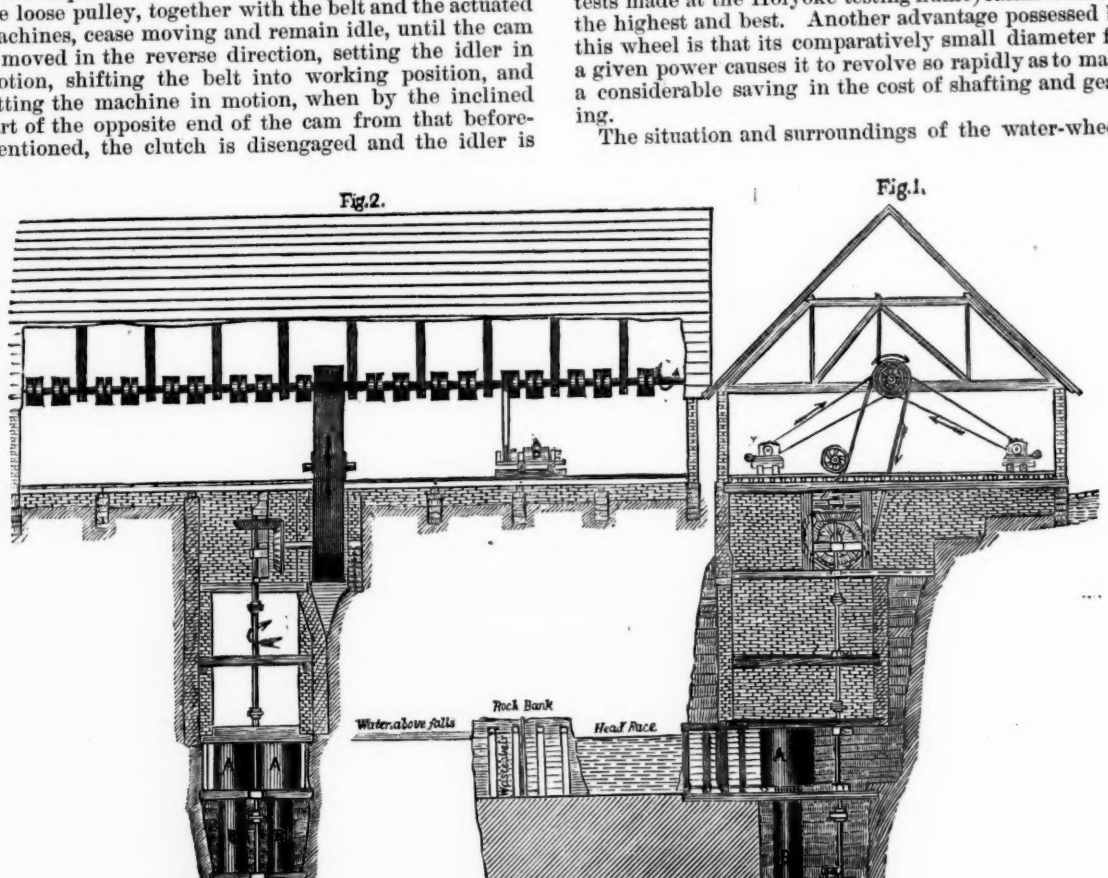
it, when, by a little further movement of the cam, its inclined part at the rear end disengages the clutch, and the loose pulley, together with the belt and the actuated machines, cease moving and remain idle, until the cam is moved in the reverse direction, setting the idler in motion, shifting the belt into working position, and setting the machine in motion, when by the inclined part of the opposite end of the cam from that beforementioned, the clutch is disengaged and the idler is again at rest, out of contact with any of the running parts.

It is in contemplation to add nine more electric machines in this same building, to be driven by the same power, should time and circumstance demand it, making 27 in all, producing 1,080 lights and requiring 1,080 horse-power. The power is to be obtained by the use of two Victor turbine water-wheels, 20 inches in diameter, made by the Stillwell & Bierce Manufacturing Company, Dayton, Ohio. This wheel is noted for the extraordinary power developed by it, in proportion to its diameter, while at the same time the percentage of power in proportion to water expended (according to tests made at the Holyoke testing flume) ranks it among the highest and best. Another advantage possessed by this wheel is that its comparatively small diameter for a given power causes it to revolve so rapidly as to make a considerable saving in the cost of shafting and gearing.

The situation and surroundings of the water-wheels and their appurtenances in this case are indeed unique and extraordinary, and indicate a perspicacity of discernment, acuteness of conception, boldness of design, and thoroughness of execution on the part of the projector, that stamps him at once as eminently qualified to place and execute a work like this, environed as it is by great natural obstacles and serious practical difficulties. To make a proper place for the flume or forebay, an open recess or bay was cut into the upper rock bank about 32 feet horizontal depth by 20 feet wide and 46 feet perpendicular depth, down to a level with

Fig.2.

Fig.1.



the bottom of the head race. The bottom of this bay is about 45 feet below the floor of the superstructure, and extends under it about 28 feet. From the bottom of this recess at its back side is a shaft about 12 feet square, sunk perpendicularly into the rock to a depth of about 90 feet, to a point some 4 or 5 feet below the surface of the backwater from the river below the falls, which are nearly 100 feet high, as will be seen by the cuts. From this shaft a culvert, extending about 36 feet in height from the bottom of the shaft, is cut through the rock out to the river, as shown in the cuts. Between the top of this opening or doorway, and the bottom of the race and forebay, is about 55 feet vertical thickness of rock, as shown in cuts, being represented in section in fig. 1.

On the bottom of said recess in the rock, and partly over the shaft therein, is the flume, containing two U-shaped iron forebays, A, A, 7 feet high, opening toward the head race, and from the bottom of which are suspended two iron stand-pipes, B, B, 76 feet and 10 inches long by 42½ inches in diameter, their upper ends opening into the forebays to receive water to supply the wheels. At one side of each stand-pipe, and connected thereto with a short cylindrical tube, is an iron wheel case, C, with a draught tube attached to its bottom, and extending some 10 feet downward, and entering the backwater. One wheel case in each figure is partly broken away to show the wheels. Besides the support to the stand-pipes by their connection with the iron forebays, A, A, they and the wheel cases, C, C, are supported at their bottoms by iron beams, as shown in cuts. The turbines are placed in the wheel-cases, C, and each one has about 58 feet of steel shafting, 3⅛ inches in diameter, coupled to it and supported by bracket-bearings projecting from the stand-pipes, B, B. Each of said shafts has on it, near its top end, a spur-pinion, 21¾ inches in diameter by 17 inch face, 17 teeth, 4 inch pitch, machine dressed. These gear into a core-spur wheel, 69⅛ inches in diameter, having 54 wooden cogs, and which is hung on near the bottom of a steel countershaft 6 inches in diameter and 60 feet long, on which, near its top end, is a bevel-wheel, 88 inches in diameter, 18 inch face, 55 teeth, 5 inch pitch, gearing into a core-bevel wheel, 99·6 inches in diameter, with 56 wooden cogs, 18 inches wide.

This wheel is on a short horizontal shaft, 6 inches in diameter, having on its farther end, beneath the floor of the building, an iron spider, carrying a wooden rim-band wheel, 10 feet in diameter by 4 feet 8 inches face, carrying a rubber belt, 4 feet 6 inches wide by ⅜ inch thick, which connects with the heretofore-described 5 feet leading-band wheel on the main line of shafting above, and drives them.

The turbines operate under 94 feet head of water, including the 10 feet draught-tubes, and are estimated to make 582 revolutions per minute, and develop 572 horse-power each, which, combined, equals 1,144 horse-power. The counter upright shaft makes 183·22 revolutions per minute, the counter-horizontal shaft, with the 10-foot band-wheel, 179·95 revolutions per minute, the main-line shaft about 359·9 revolutions per minute, and the electro-dynamos 755·79 revolutions per minute.

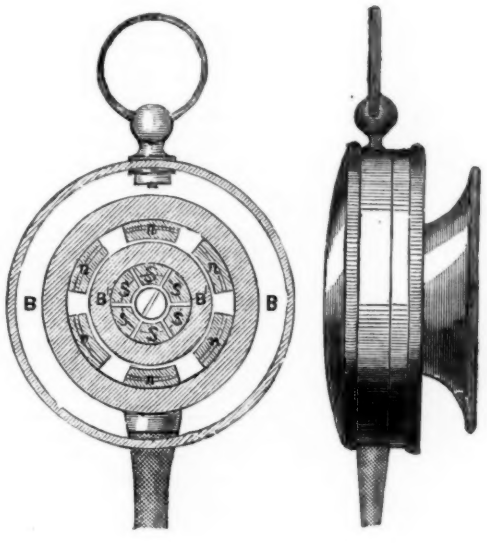
This work has all been carried out under the direction and immediate supervision of Mr. Joseph Cowles, of Rochester.

Arc Lighting Competition.—A competition trial of the three most prominent systems of arc lighting—viz., the Brush, the Weston, and the Thomson-Houston, was made last February, says the New York *Electrical Review*, at Quincy, Ills., and a committee consisting of the Mayor of Quincy, the Common Council, and twelve prominent citizens, "upon due investigation as to the merits of simplicity of machinery and lamps, steadiness of light, colour of light, and amount of light," gave the highest award to the Thomson-Houston apparatus, made at New Britain, Conn. As a sequel to this trial, the city of Quincy has now given a contract to the Thomson-Houston Electric Company for lighting a considerable portion of the streets of the city.

M. TESTU'S TELEPHONE.

M. TESTU, of the French administration des postes et des télégraphes, has devised a magnetic telephone, which for several months has given excellent results.

According to a description in *La Lumière Electrique*, it resembles externally a strong watch, of which the glass is replaced by an ebonite mouthpiece. The iron plate vibrates before a double magnetic ring, having projections like the indented edges of two concentric cups. The magnetic polarity is different in the two



rings; each of them is provided with a coil of fine wire, so that the entire magnetic field is traversed by the current.

This form, represented in the drawing, and constructed by La maison de Brauville et Cie, could be advantageously employed as a receiver in any micro-telephonic post.

PATENTS FOR INVENTIONS BILL.

MR. S. A. VARLEY, whose name is so well known in connection with electrical matters, has recently addressed a letter on the above subject to the *Times*. We think this of sufficient interest to reproduce, as his reasoning appears to us to be quite in accordance with the views of those who have considered the matter carefully. We should be glad to see this subject well ventilated, and our columns will be open to any of our readers desirous of so doing. Mr. Varley's communication is as follows:—

"The introduction of a new invention is necessarily very uphill work under most favourable conditions, but if the inventor has to face litigation at the very outset he will be almost certainly crushed by the expenses in which he will become involved.

"Under the law now in force the granting of a patent is seldom opposed, and for this reason, the specification describing the invention is only open to the law officers, who decide whether it is subject matter for a patent or not, and the specification remains a sealed document, as far as the public are concerned, until after the patent has been granted or refused; but if it be granted it can then only be upset by an action at law. This provision I consider a very wise one, as unless there be good grounds for opposing, opposition is not likely to be successful. But in the new Bill, Clause 10 provides that after the inventor has satisfied both the Controller and the Examiner that his invention is a proper subject for a patent, the complete specification and the

drawings describing the invention shall be advertised and open to public inspection for two months before the patent is granted, and that during this interval any one who chooses may lodge an opposition to its being granted, the effect of which in any case is costly litigation.

"I will give the history of an opposition to an important invention which occurred a few years since, omitting the names of the parties to the suit, whom I will distinguish as A. and B. About 1866 A. introduced an invention of scientific interest; in 1870 B., with a more correct appreciation of scientific principles, patented an invention, the mode of action of which was then very imperfectly understood by our scientific experts, but which has already produced most important consequences, and made the name of B. known all over the world. Naturally the machines of B. have superseded to a considerable extent those of A. In 1878 B. applied for a patent for a further improvement. Nineteen days after this A. applied for a patent for a machine of very different construction, but for producing similar results as B.'s invention. Availing himself of an accidental defect in the drawing up the Bill of the patent law now in force, A., although later in the field, managed to obtain the Great Seal first. Having succeeded in doing this he lodged an opposition to B., and also obtained an injunction to restrain B. from using his invention (which had been exhibited and worked at this period) pending the result of an action at law.

"The opposition was argued by able counsel on both sides before the Attorney-General, and A. was successful to the extent that although B. was allowed his patent, the Attorney-General altered the date of B.'s to the day after the date of A.'s application, so as to allow A. to try the case by an action at law. As the period allowed for granting the Seal had now expired, B. had to petition the Lord Chancellor to allow it to be issued, and was in the end successful. The trial was delayed from time to time at the instance of the parties to the suit, and eventually was allowed to fall through by A. after the defence had been put in. The expense and delay of this litigation, and the hindrance to the introduction of the machine caused B. to offer to part with the patent for a very moderate amount, but no purchaser could be obtained until after the action had been allowed to fall through, when it at once became a valuable property, and was almost immediately afterwards purchased.

"At the time this opposition occurred B.'s name was well established, and he possessed the advantage of financial support. Notwithstanding these advantages no headway could be made in England with his invention until the litigation was disposed of.

"But suppose there had been a similar provision in the patent law in 1870, when B. patented his original invention, as that of Clause 10 in the new Bill, and suppose, what would very likely have occurred, that A. had lodged an opposition to it, with the advantage, too, of having seen B.'s specification, and also of being assisted by able counsel and scientific experts, what chance, I would ask, would B. have had of obtaining the necessary financial support to meet the expenses of costly litigation, assuming he was not a rich man, which inventors as a rule are not. The probability is that the introduction of a most valuable invention would have been delayed, and the inventor would have obtained no reward whatever for his ingenuity.

"It seems to me the common sense course to adopt would be to appoint for the Controller and Examiner men of good general knowledge (not experts), of whom there are plenty to be found in this country, and to throw upon them the responsibility whether patents be granted or refused. Vested interests are, in my opinion, sufficiently protected by the fact that all patents are capable of being set aside by a law suit if there be good and sufficient reasons for doing so. Sir John Lubbock moved an amendment in the House of Commons to Clause 10, which was not carried on the ground that it would deter all but rich men from attempting to protect their inventions."

NOTES.

Electric Lighting.—Blake's restaurant and dining rooms under the Bradford Exchange has lately been furnished with the electric light. 100 Swan lamps of 20 candle-power are worked from a "Ferranti" 100 light machine, which is excited by a small Siemens' machine. The engine employed is a 6 horse-power Otto & Crossley gas engine. The whole arrangement is, we are assured, well carried out, and its great advantages over gas are at once felt by the frequenters of the place. The engineers are Kingsland & Smith, of Leeds.

The directors of the Peninsular and Oriental Company have resolved to begin fitting their steamers with the electric light. A start is to be made with the s.s. *Valetta*, now building at Greenock. The lighting has been entrusted to the Edison Company.

On Friday evening of last week the members of the St. Peter's United Ratepayers' Society celebrated "the victory gained by the ratepayers of St. Mary, Newington, against reckless expenditure and the electric lighting scheme of their vestry," by a dinner at the Bridge-house Hotel, London Bridge, and subsequently a deputation from the society waited upon Mr. Edward Yates, and presented him with a testimonial in the form of an illuminated text "as a tribute of respect and in testimony of his unswerving efforts to prevent reckless expenditure and increased rates, as shown by his determined opposition to the electric lighting scheme, which a clique in the vestry of St. Mary, Newington, persistently endeavoured to thrust upon the parish at the expense of the general body of ratepayers, and from which they would never have derived any benefit."

In the House of Lords on Saturday last the royal assent was given by commission to the Electric Lighting Orders Confirmation (Nos. 1 to 11) Acts.

The largest shipping contract for electric lighting up to the present time was on Saturday last concluded in Glasgow between the owners of the New Zealand Shipping Company's fleet and the Edison Company's branch in Scotland, under the management of Mr. Charles T. Grant. Three fine steamers, two of which are sister ships to the s.s. *Tongariro*, launched at Messrs. John Elder & Co.'s yard on the previous Thursday, are to be lighted throughout with the incandescent light, and fitted with a duplicate set of Edison's marine dynamos and engines, one set being for reserve in case of emergency. These steamers, when finished, will be the finest electrically-equipped vessels afloat.

The latest addition to the Clan line of steamers, belonging to Messrs. Cayzer, Irvine & Co., built by Messrs. Scott & Co., Greenock, is a magnificent vessel, of 3,800 tons gross, 380 feet in length, and 43 feet beam. Each of the passengers' cabins has Edison's electric incandescent light, and, failing it, the lamps are so arranged that oil can be substituted in a moment by simply turning back the Edison bracket. The electric light was used from Glasgow to Liverpool, and acted splendidly, illuminating the cabins, saloon, and engine-room as if it were day. The side-lights burned beautifully, and as this style has now been adopted they will, it is thought, become generally used. Several of the Edison Company's workmen accompanied the ship to Liverpool, and experimented with the lights in a most satisfactory manner. The four cargo lamps, of about 300 candle-power, were hoisted up amidships, and one of them moved to the yardarm by a small line, and from thence to the forecastle-head, with the greatest accuracy, only occupying a few seconds. The same lamp was lowered to the water's edge, and lighted up the surface of the water throughout the whole of the Liverpool dock. By a system of switches the light can be turned off at almost any point in groups or at every lamp.

The Adelaide Gallery Restaurant (Messrs. A. & S. Gatti) has been wired for about 320 Edison lamps, and the electric machinery is about to be laid down. The plant will be in duplicate throughout. Two "Field" vertical multi-tubular boilers, two "Armington & Sims"

high-speed engines, and four 150-light Edison dynamos will be placed in the basement adjoining the rooms to be lighted.

The Edison Company has for several months lighted a considerable portion of the Holborn Restaurant with about 800 lamps, and arrangements are now in progress for laying down plant for upwards of 1,000 additional 16-candle lamps. The plant employed will be similar to that used at Messrs. Gatti's, but of proportionately larger capacity. When lighted throughout the Holborn Restaurant installation will be the largest of its kind hitherto made.

Presentation.—About a fortnight since a few friends and well-wishers of Mr. J. D. Miller, the Greenock manager of the National Telephone Company (Limited), presented that gentleman with a handsome silver inkstand on the occasion of his leaving that town to fill the important post of manager of the Aberdeen centre, where there are over 200 subscribers.

The Telephone at Balmoral.—The important telephonic communications ordered to be erected for Her Majesty at Balmoral have recently been completed. The wires radiate from the Castle at Balmoral to the Albert Memorial Hall at Ballater; to Abergeldie Castle (the Highland residence of His Royal Highness the Prince of Wales); and to the house of Dr. Profeit (Her Majesty's Commissioner) at Craig Gowan. Arrangements have been made for the whole of these places to have telephonic intercommunication; and, further, as Ballater is the nearest telegraph station to Balmoral, messages for Windsor, Osborne, and other places will be telephoned to the Albert Memorial Hall, and thence handed to the Ballater Post Office for transmission by telegraph; and, on the other hand, telegrams received at Ballater for Balmoral, Abergeldie, or Dr. Profeit will be telephoned to their destination after being handed over by the telegraph officials to the telephone operator for that purpose. The operations have been carried out by Messrs. Tasker, Sons, & Co., telephone engineers, Sheffield, who, in order to complete the communications before the arrival of Her Majesty on the 25th ult., employed a large staff of workmen, under the personal direction of Mr. Johnson, their engineer and electrician. Conversation over the wires can now be carried on with the most gratifying ease and distinctness, and so marked was the success of the whole of the arrangements that special messages notifying this fact were despatched by the new system from Balmoral to Her Majesty at Osborne. The instruments adopted are Johnson's transmitters, authorised to be used by the Attorney-General, and Bell's telephones.

The Royal Aquarium Electric Light Exhibition.—At an extraordinary or half-yearly meeting of the Royal Aquarium and Winter Garden Society, held on Thursday fortnight, Captain Molesworth, R.N., who presided, said the directors had been much disappointed at the result of the electric exhibition, which was undertaken under the advice of experts and on the best possible information they could get from the electrical world. They were led to believe that they would get £1,200 from the letting of space to the exhibitors, and assured that the expenditure would not exceed that amount, and they were further assured that they would also save in the amount they had previously paid for gas. But in all these matters the directors had been disappointed, the various items having produced far below what had been anticipated, and instead of an 8 or 10 per cent. they were only enabled to pay a dividend at the rate of 4 per cent. In the last part of the half year they had to contend with the National Fisheries Exhibition, at which the electric light was given gratis.

Vienna International Electrical Exhibition.—Exhibits sent by the Society of Telegraph Engineers and Electricians.—We subjoin a list of instruments and articles of interest which have been forwarded to Vienna last week by the Society of Telegraph Engineers and Electricians in response to an urgent request from the British Commissioners that the society would collect from among its members such exhibits as they could obtain at this late period. Had such an arrangement been decided upon earlier, of course a far larger collection might have been gathered together. Lent by Mr. Latimer Clark, Past President—Portion of original telegraph line laid by Cooke and Wheatstone; portion of first cable laid between England and France; original models of dial telegraph, 1816; original type cast in 1832 for the electro-magnetic telegraph by Morse; portion of the original telegraph line laid by Ronalds, 1816; insulators used by Morse. Lent by Mr. W. Groves, Associate—Set of apparatus for illustrating Mr. Stroh's experiments on attraction and repulsion due to vibration, and a comparison between the phenomena with those of magnetism; Prof. Hughes's induction balance; ditto sonometer; ditto torsion balance. Lent by Mr. R. Sabine, Member—Original Wheatstone bridge; ditto photometer; ditto resistance coil. Lent by the society—Original letter from the late Philipp Reis to Mr. W. Ladd, dated 13th July, 1863, describing his telephone; original hand-bills advertising the telegraph between Paddington and Slough, 1845. Lent by Sir William Thomson, Past President—Thomson's patent azimuth compass; ditto, sounding apparatus; ditto, graded galvanometer for potential; ditto, graded galvanometer for current.

The International Fisheries Exhibition.—A meeting of the general committee was held at South Kensington on Tuesday, Mr. Edward Birkbeck, M.P., presiding. The report of the executive committee, which was submitted, stated that, "owing to the great extent of the installation of the electric light, the committee were unable to keep the buildings open after dark so soon as they had anticipated; but the electric machinery has now been in working order for some considerable time, and has been a most important factor in increasing the number of visitors. A special feature in the electric lighting has been the erection, in the gardens, of a tall mast surmounted by a corona of arc lamps of considerable power, which light with extreme brilliancy the whole area of the gardens." The chairman subsequently addressed the meeting, and said the electric light had been the greatest possible assistance to the Exhibition; and he ventured te say that in future exhibitions the electric light would be an important factor to their success. It had been a great expense, no doubt, but they had carried it out at as little expense as possible, and they were quite convinced that it had proved a great attraction, and the result of the number of visitors after six o'clock more than justified the outlay they had made. The report was adopted.

In addition to the accounts of the exhibits of the firms engaged in the electric lighting of this exhibition given in our issue of the 11th ult., we have to mention that the Canada and United States Court is illuminated by Mr. Mackie with 15 powerful Lea arc lights of about 2,500 candle-power each. They are arranged in series of five, the current being supplied from a distance of about 150 yards by three Gramme E machines of special pattern. The lights are inclosed in large translucent opal globes of only sufficient opalescence to cut off the painful brightness of the arc itself, and the effect is very pleasing. Mr. Mackie's installation consists of four E machines, fed by two A Gramme machines of the ordinary type, three of which, as before mentioned, are serving 15 of the Lea lamps in the Canada and United States Court, and the fourth, six Werdermann semi-incandescent lights in the Board of Trade shed. One of the three sets of Lea lamps was, it may be added, run at the Crystal Palace from the 13th December to the 13th April without any covering to the lamps, the works being exposed to the wind and dust. On being taken down they were, without having been repaired or cleaned, adjusted at this exhibition, where they

have been running since the 16th May. The intention is that these lamps should run till a break-down occurs in order that it may be ascertained at what point this will first take place. The hall of the Shipwrecked Mariners and Fishermens' Institution, as we briefly mentioned last week, is also illuminated by Mr. Mackie by about 30 of Messrs. Wright & Mackie's incandescent lamps, giving from 22 to 25 candle-power light each. These strong lights are inclosed in opalescent globes of considerable size, by which means the light is distributed throughout the room with great uniformity and softness. The fittings generally are very simple, and amongst them are six mermaid brackets with ornamental glass shades, furnished with switches and specially intended for ship uses.

Sixpenny Telegrams.—In the House of Commons on Thursday fortnight, Mr. Fawcett, in reply to Mr. J. Cowen, stated he was most desirous to introduce the reduced tariff for telegrams as soon as possible, but it was necessary to make adequate preparations, because, if not, the increase of messages that was anticipated when the sixpenny tariff came into operation would be so great that many of the wires would be blocked, and a great deal of inconvenience caused to the public. He might mention that it was estimated that 15,000 miles of new wires would be necessary before the reduced charge could be brought into operation. The Treasury minute stated that the reduced charge would come into operation on the 1st of October next year. There were several thousand miles of telegraph wire to lay. In anticipation of the sixpenny telegrams, the Government are providing for a more direct line of telegraphic communication between London and Exeter. Lieutenant C. K. Wood, of the Royal Engineers, recently appeared before the Salisbury Town Council, and explained the scheme, asking permission to lay down a new line of telegraphic poles through the city. He described the route, and said that the Government anticipated a great increase of business from the cheap telegrams. The poles would be laid from Basingstoke to Andover, and thence to Exeter. The Council gave their conditional approval of the proposed route through Salisbury. It has been estimated that the sixpenny telegram system will involve an expenditure of £500,000 for new wires and apparatus.

Post Office Telegraph Department.—Considerable dissatisfaction is expressed, says the *Pall Mall Gazette*, in many quarters as to the inability of the Telegraph Department of the Post Office to supply the wires necessary for the increasing business certain to result from the introduction of sixpenny telegrams. For a long time past the Post Office officials have declared that the sole obstacle in the way of sixpenny telegrams was the reluctance of the Treasury to meet the expenditure that would be necessary. Now that the Treasury has undertaken to defray all the cost, it is declared that the resources of the department are quite inadequate to supply the requisite apparatus to meet the increased demand until October next year. It is to be feared that this revelation of sluggishness is not calculated to give any healthy stimulus to the movement now existing in the United States in favour of the establishment of Post Office telegraphs.

The Armington & Sims Engine.—A trial of eighteen Armington & Sims engines by the American Electric and Illuminating Company. in various stations, has resulted so satisfactorily, says the New York *Electrical Review*, that an order has been given for seventy-five more to be constructed as rapidly as possible. A letter from Mr. Armington, in England, announces the sale of the right to use the Armington & Sims engine in Great Britain, at the schedule price originally adopted by the foreign syndicate.

The Hammond Electric Light Company.—Some excitement has been aroused amongst the shareholders of the Hammond Electric Light Company by the call which has been made. It is alleged, says the *Citizen*, that the fact of this call was known to some of the shareholders, especially to members of the Stock Exchange, before others; but we cannot see that the action of the directors can here be called in question. We cannot avoid noticing, however, the concluding remarks in the circular addressed by the board to the shareholders. They allude to Mr. Hammond's visit to America, and continue :—"It is not improbable that some portion of the capital now called up may be judiciously and profitably employed in working an American patent, which will, it is believed, have a marked influence in cheapening the supply of electric light." Are we to infer from this that the Brush and Lane-Fox systems are to be abandoned, or only partially employed, in favour of this new American system? If so, where is the value in the £35,000 ordinary *plus* the founders' shares paid to Mr. Hammond for the use of his licences? Moreover, as this gentleman retains two-fifths of the profits, we presume he also defrays at least two-fifths of the expenses of visiting America and investigating the improved patents. Of course Mr. Hammond will not think of retaining £35,000 for his licences if they are proved commercially useless?

The Gulcher Electric Light & Power Company, Limited.—In another place we publish the report of the directors of this company. It is by no means encouraging, for even according to their statement the deficiency on the working of fourteen months ending June 30th, 1883, is £18,678 8s. 8d. Excepting only a very few items, we do not purpose considering the details of these accounts. We must, however, take exception to the amount written off *Patent Account*. £6,500 is not sufficient for the time covered (by the accounts) for patents which are stated to have cost £136,273 1s. 3d., nor do we think the £1,750 director's fees (in addition to managing director's salary) well earned, when they can show, on the balance-sheet covering a period of a little more than one year only, a loss of over £18,000. According to the trading account, the sale and hire of lamps and dynamos have produced £5,646 15s. 1d., and the stock is valued at £12,300, together £17,946 15s. 1d., the expenditure for which result is estimated to have been £24,821 12s.. It would probably pay better to pension the directors and to stop work; the shareholders would find the capital (what there is left of it) last longer, and more of it might find its way back to their pockets in the shape of unearned dividend. However, to speak seriously, we hope that at the dark *séance*, held last Wednesday, the shareholders were able to take the necessary steps to enable them to avert, in the future, such a *fiasco* as is promised by what has taken place in the past.

The Great Western Electric Light & Power Company, Limited.—The report of this company also is now before us. It may be summarised as follows :—The loss on trading from April 6th, 1882, to June 30th, 1883, amounts to £3,801 13s. 9d., but owing to the receipt of a sum of £6,250, from sale of concession to the Devon and Cornwall, &c., Company, this is converted into a nett gain (on the total profit and loss account) of £112 14s. 6d. As the latter Company is in liquidation, the concessions sold to it have now reverted to the Great Western Company. There are one or two points noteworthy, in the general balance-sheet, which place this company in a rather more favourable position than some of its contemporaries, in its assets but a small proportion of the amount thereof is invested in plant and stock (£6,555 12s. 7d.), whilst there is a considerable balance of cash in hand and at deposit of £22,243 19s. 7d. The liabilities are put down at £2,082 4s. 6d., with a contingent liability of £1,250. There is also the possible cost of the law suit, mentioned in the directors' report, which must not be forgotten in estimating the general position of the above company. It will be seen from the report that it is proposed to make all shares fully paid up by reducing the amount of the shares to what has been called, but this matter remains at present in abeyance.

The Electric Railway at Brighton.—Mr. Magnus Volk, the constructor, gives us the following information concerning this railway, which was made very hurriedly, and the line, car, &c., completed in about 18 days, including the moving and fixing the engine and dynamo, and adapting a dynamo used as a motor. The generator consists of a Siemens' D 5 machine, running at 1,700 revolutions per minute. The gas-engine is one of Crossley's 2 H.P. nominal, with two fly-wheels, turning at 160 revolutions per minute. The dynamo used as a motor was made by Mr. Volk, and it weighs about 2¾ cwt. It makes 700 revolutions per minute; and the speed of the car up an incline of 1 in 100 is about 5 miles per hour, the return down the incline 10 miles per hour. The gearing is by means of pulleys and belts. The car carries 12 passengers, exclusive of the driver, but has carried 16 adults, and is illuminated at night by a 20-candle Swan lamp. The motor stands on one of the footboards, covered by a box. The reversing is effected by a commutator switch, which inserts several resistances before breaking the circuit, so that but little sparking takes place; the same handle that actuates the switch also alters the lead of the brushes, one pair only being used. The track is about ¼ mile long, resting on the shingle; ordinary flange rails and longitudinal sleepers are used; the rails are connected by No. 8 copper wire, loops bolted on with ⅜ bolts. On last Bank Holiday, that being the first public day, the car ran 11 hours without a hitch, conveyed 1,200 passengers, and ran 50 miles, and has continued running without any interruption up to the present time. The loss, even during rain, does not exceed 10 per cent., and in dry weather less than 5 per cent. The rails only are used as conductors, and the wet weather has not interfered with the working in the least. It may be interesting to compare this installation with the Chicago Electrical Railway, described in our last issue. Engine, 2 H.P. nom., about 3½ indicated; current, 18 ampères; E.M.F., 55 volts; weight of motor, 2¾ cwt.; weight of car, 7 cwt.; load, 12 persons, 1 ton; gradient 1 in 100; speed, mean, 7 miles per hour; daily journey, 25 to 30 miles; daily average of passengers, 350. Application is now being made to extend the system along the whole front of Brighton, under the Esplanade Wall, a distance of two miles, and to run cars in both directions every 10 minutes, and also to have an electric hoist to convey passengers up the face of the eastern wall, a height of 62 ft. The expenditure to convey 12 passengers 60 journeys of ½ mile each is, according to Mr. Magnus Volk, as follows:—

	s.	d.
Gas, 10 hours @ 3d.	2	6
Oil and waste, total	0	8
Conductor	3	4
Labourer to clean and attend to engine, repair shingle track, &c.	4	2
Depreciation, 15 per cent. on £500 say	5	0
	15	8

Or a trifle over ½d. per mile per passenger. As the car is only running five minutes and standing five minutes, the carrying capacity can be multiplied by two, the only increased expense being 50 per cent. extra gas, the cost in wages remaining the same, so that the cost is only a trifle over a ¼d. per mile per passenger, supposing it runs full every journey.

The Distribution of Electricity.—The following letter appeared in last week's issue of *Engineering*:—

"In your impression of the 10th inst., you published a letter from Mr. Gisbert Kapp, in which he criticises the figures given in our project for lighting the Suez Canal by our system, and states that the primary current would have an electromotive force of 9,000 volts, and that the weight of copper for the main conductor would be 160 tons. Mr. Kapp also is of opinion that the machine of Mr. Marcel Deprez, producing an electromotive force of less than half that we propose to employ, not having worked well at Munich, it is difficult to believe how an alternating current machine could safely work at the enormous potential of 9,200 volts.

"With regard to the first point, we repeat in detail the figures already given. Each lamp would require three ampères of a current of 90 volts electromotive force, 1,280 lamps would consequently take 345,600 Watts. This energy furnished by the transformation of a primary current of 16 ampères, would consume of this primary current $\frac{345,600}{16} = 21,600$ volts, to which must be added the loss by secondary generation of 15 per cent., say 3,240 volts. The resistance of the circuit, being 320 ohms, would consume under the same conditions 5,120 volts of the primary current.

"We have, therefore, a consumption of electrical energy represented by 16 ampères, and 29,960 volts. The project, however, includes the installation of arc lamps at the stations, which would represent a further consumption of about 8,000 volts of the primary current. We have thus a total of 37,960 volts.

"The electromotive force of our primary current is given in our project as 40,000 volts in round figures. Further, we have described our primary circuit as being composed of 19 copper strands of No. 18 B.W.G., forming a total section of 23 square millimetres, and the weight in copper for this conductor of 320 kilometres in length would be 58 tons, and not 160 tons.

"As to the question of a dynamo machine being capable of producing a current of 40,000 volts, which up to the present time has appeared startling, and regarding which Mr. Kapp is incredulous, the case of Mr. Marcel Deprez's machine, cited by Kapp, presents no argument, for in planning his machine Mr. Deprez sought only suitable conditions for the solution of the problem, which he discussed in *La Lumière Electrique* of December 8, 1881, and did not contemplate the construction of a high tension dynamo machine. It is incontestable that in any known type of dynamo machine it is impossible to produce such currents as are referred to above, and the machine of Mr. Deprez is, in effect, only a Gramme machine.

"It has long been known that fixed armatures (such as that of the Ruhmkorff coil, for instance) will give rise to currents of considerable tension without prejudice to their insulation, on condition, however, that the resistance of the exterior circuit is not opposed to the closing of the current. For this reason we have devised a dynamo machine to produce our currents of high tension, having several exterior fixed armatures separately influenced, and coupled automatically in tension according to the external resistance of the circuit, while at the same moment the movable field-magnets are excited in derivation by a separate exciting source.

"It is easily understood that induction, whether produced by the movement of a current or by that of an electro-magnet, would not alter the mode of action of the armature.

"Our project is, therefore, neither too expensive nor too beset with practical difficulties as Mr. Kapp appears to think. It is a necessary consequence of the results we have invariably obtained and repeatedly shown to those who have evinced an interest in these demonstrations.

"A practical installation of our system of distributing electrical energy at several points of consumption, united by a single circuit of three millimetres in diameter and of 24 kilometres in length, will shortly be completed on the Metropolitan Railway, and will incontestably prove the correctness of our estimates.

"The National Company for the Distribution of Electricity by Secondary Generators, Limited.
"L. GAULARD, Chief Engineer."

We may here mention that the work in connection with the lighting of five stations of the Metropolitan Railway by the National Company for Distribution of Electricity, &c., is approaching completion. The dynamo machine (an alternating Gramme) is already fixed. The wire has been erected by Messrs. Henley's Telegraph Works Company, the line being suspended on insulators on each side of the tunnel. The same firm is carrying out the wiring of the stations. The Henley Company has had some trouble in erecting the line, as it is only possible to work between the last train at night and the first train in the morning—about four clear hours. The stations to be lit are Aldersgate, Farringdon Street, King's Cross, Edgware Road and Aldgate.

The Spanish National Telegraph Company.—According to the *Correspondencia* of Madrid the Spanish Government has told off the war frigate *Concepcion* to accompany the cable steamers *Dacia* and *International* during the laying of the Cadiz-Tenerife and inter-insular cables. The *Concepcion* is at present anchored at Puntales awaiting the arrival of the cable vessels.

The Electric Carbon Storage and Apparatus Manufacturing Company of Scotland, Limited.—Referring to our "Note" on p. 148 of last issue, we shall still be pleased to receive the names and addresses of any creditors of this company, who have not as yet forwarded them.

The Duplex Electric Light, Power, and Storage Company (Limited).—It will interest some of our readers to know that a movement, supported by several

creditors and shareholders, is on foot to oppose the appointment of any liquidator that may be nominated, or supported, by the British Trading Company or its promoters, and the instigator of the petition (for winding up the Duplex Company), Mr. Stephen Henry Emmens, or any of his friends who have been associated with him hitherto in the conduct of the affairs of that Company. Also instructions have been given to Mr. J. N. Jonas, solicitor, of 8, Union Court, Old Broad Street, to endeavour to procure the appointment of an independent liquidator of the highest standing in the profession, who will secure the assets of the company (now threatened with total loss), and who will act in such a way as will advance the interests of the general body of shareholders and creditors. It is, we believe, intended to propose Mr. Wm. Waddell, of the firm of Messrs. J. & W. Waddell, for the said appointment.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Mexican Gas and Electric Light Company, Limited.—The return of this company, made up to the 15th ult., was filed on the 18th ult. The nominal capital is £100,000 in £20 shares. The whole of the capital has been taken up and fully paid. Registered office, 15, Bishopsgate Street Within.

John Northam & Co., Limited (electrical and other signal manufacturers).—The first return of this company, made up to the 11th July, was filed on the 18th July. The nominal capital is £500 in 100 shares of £5 each. Forty-eight shares have been taken up, and upon these two calls of 10s. per share has been made payable on July 26th and October 26th respectively. The sum of £12 has been received by the company in advance of calls. Registered office, 30, Norfolk Street, Sheffield.

Midland Telephone Company, Limited.—At an extraordinary meeting of the shareholders in this company, held on the 22nd of April at 2, Exchange Chambers, New Street, Birmingham, it was resolved that the company be wound up voluntarily. The resolution was confirmed on the 9th of May, and at a meeting held on 13th ult. the shareholders were informed as to the manner in which the winding up had been conducted and the property of the company disposed of.

Gülcher Electric Light and Power Company, Limited. The registered office of this company is now situate at the Battersea Foundry, Battersea.

Telepherage Company, Limited.—By an agreement dated 31st March, the patentees of telepherage, Messrs. Fleeming Jenkin, F.R.S., of Edinburgh, and Wm. Edward Ayrton, F.R.S., and John Perry, M.E., of the Technical College, Finsbury, receive from the company for the assignment of their patent rights the sum of £25,000 in fully paid shares of £10 each. The registered office of the company is now situate at 53, Old Broad Street, E.C.

St. George Telephone Company, Limited.—In accordance with an agreement of 15th of August, filed on 16th ult., this company will issue to Mr. Arthur French St. George, of Redhill, Surrey, 4,000 fully paid shares of £5 each, in satisfaction and discharge of the sum of £20,000, on account of the consideration to be paid to him pursuant to an agreement of 9th of August. The office of the company is removed to 20, Bucklersbury.

NEW COMPANIES REGISTERED.

West London Electric Lighting Company, Limited.—Capital, £60,000 in £10 shares. Objects: To carry on the business of an electric lighting company in all branches. Signatories (with 25 shares each): Sir Daniel Gooch, Bart., M.P., 3, Warwick Road, W.; Marwood Tucker, 3, Cleveland Row, St. James; Sir George Eliot, Bart., M.P., 1, Park Street; Philip Rawson, J.P., Crawley, Sussex; G. W. Campbell, 22, Queen's Gate Gardens; J. E. H. Gordon, 28, Collingham Place, S.W.; Louis Floersheim, 4, Bank Buildings, E.C. The signatories are to nominate the first directors—qualification, 25 shares. Registered 22nd August, by Bircham & Co., 26, Austinfriars, E.C.

Electric Signal Company, Limited.—Capital, £1,500, in £10 shares. Objects: To acquire and work inventions relating to or appertaining to electricity. Signatories (with one share each): L. Maitland, 2, Fopstone Road, Earl's Court; C. W. Pridham, 62, Hogarth Road, S.W.; A. Schofield, 17, Earl's Court Square; W. J. M. Cormack, Paignton, Devon; W. A. Stewart and C. W. A. Stewart, 38, Courtfield Gardens, South Kensington; B. Dickenson, Bourne End. Directing qualification: Shares to the nominal value of £100. Registered 22nd August by Hy. Sparshatt, 93, Finborough Road, S.W.

CITY NOTES, REPORTS, MEETINGS, &c.

The London and Provincial Electric Lighting and Power Generating Company, Limited.

THE first annual general meeting was held at the Cannon Street Hotel on Thursday, Mr. J. Dunham-Massey, one of the directors, presiding.

The Secretary (Mr. G. H. Redwood) read the notice convening the meeting, and also the minutes of the first statutory meeting, held on the 7th September last.

Several of the shareholders pointed out that they had had no intimation and knew nothing of the meeting on the 7th September. The Secretary explained that it was convened by advertisement. The shareholders expressed their disapproval at their not having received direct intimation. The solicitor (Mr. Edward Lee) pointed out that such a statutory meeting was merely formal.

The report of the directors for the year ending 31st July, which was taken as read, was as follows:—In presenting this, their first annual report, the directors are reluctantly compelled to commence with an expression of regret that the result of the past year's work has not been of such a satisfactory nature as was certainly to be looked for and expected. The extraordinary changes which have occurred in the progress of the electric lighting industry are too well known to require any lengthened dissertation upon the subject, but it may be well to briefly recapitulate the events which have influenced this company in its career. The depression in electric lighting generally which set in so shortly after the allotment of shares, combined with excessive competition from other companies, had a detrimental effect upon the company's operations. The directors made great and constant efforts to procure advantageous contracts, but declined to take any which would not prove remunerative. It was, of course, necessary to the obtaining of contracts that an installation of the company's lamps and machinery should be ready for inspection by any intending consumer, and for that purpose suitable premises were obtained at Newington Causeway, and the necessary machinery and plant erected there, which were inspected upon completion and approved by the company's engineer, Sir Charles Bright. The Directors have great pleasure in stating that by means of the experiments and experience they have thus obtained they have perfected the company's arc lamp, which they consider now to be in efficiency and economy of working superior to any in the market. A few months back negotiations were commenced with Messrs. Monico Bros., relative to the lighting of the café "Monico," in Tichborne Street, and on the 4th of June last a contract was entered into with Messrs. Monico, by which the company agreed to light their premises for one year at a satisfactory rental, and a suitable place having been procured, the company's works were removed to Denman Street, adjoining the premises above referred to. The company have been fortunate in securing these premises as a centre of operations, as they are surrounded by places of public amusement highly adapted for electric lighting, and the directors have good reason to believe that this will prove an excellent opening for future advantageous business. Under these circumstances the Directors propose to make a further issue of capital to enable the work to be efficiently carried out and extended.

The balance sheet shows:—*Liabilities*: To capital, viz., 8,000 shares of £5 issued to vendors, £40,000; 5,813 shares of £5 subscribed for and allotted, £29,065 (together, £69,065); to sundry creditors, £718 13s. 10d.; to F. E. M. Steele (a contingent liability payable out of money received from sale of concessions, £12,000; to directors' fees, not drawn, £920 2s. 5d.; total liabilities, £82,703 16s. 3d.—*Assets*: By patent rights and concessions, £70,030; by debtors—arrears on shares, £3,422; sundry debtors, £48 3s. 8d.; by machinery, tools, and implements at works, £561 14s.; by office furniture, fixtures, and fittings, £186 7s. 10d.; by lighting centre (machinery and construction expenses at prime cost), £1,891 1s. 7d.; by preliminary expenses, £2,397 10s. 4d.; by cash at bank and in hand, £335 4s. 1d.; total assets, £78,872 1s. 6d.; leaving balance loss, £3,831 14s. 9d.

The Chairman said he was sorry to have to tell them that he

held in his hand a telegram from the chairman of the company (Lord Wallscourt), who was in Ireland, and could not possibly return in time for the meeting; and their vice-chairman (Mr. Hubback) was dangerously ill. The duty of taking the chair had therefore devolved upon him. The history of that company was very similar to all other electric companies. The circumstances connected with the career of all such companies were no doubt thoroughly well known to them all, and their position he presumed was much the same as that of the others. They had gone through an initiatory period, and up to now they had not many results to show them; no electric companies, he believed, had. When the company was incorporated they had negotiations in hand for the sale of concessions in many counties in England. Unfortunately none of these they had been able to carry through. These negotiations were not the outcome of bogus applications. The applications came from responsible persons, most of them solicitors in London, and it was much to be regretted that circumstances prevented their being carried out. Had they been carried out they should have had their money returned to them in full for the sale of the concessions. Their first duty was to take works where they could show their light and manufacture lamps when the period for such manufacture arrived. They took works on a small scale, but sufficient for their purpose, in Newington Causeway, where the lamps had been visible until recently. In the absence of definite orders they devoted their attention to the improvement of their plant and apparatus, and he was glad to be able to say that they perfected their arc lamp to such an extent that they felt justified in saying it was equal to, if not superior to, any other to be had. They were in possession of good apparatus. The Gramme dynamo machine required no eulogy; he supposed it was as good as any other, if not better, and their own lamp they knew to be all that they required in the meantime. They endeavoured to obtain contracts, and they tendered in many quarters. They considered all the contracts that was offered to them, but unfortunately they were not able to accept any at the prices offered; they would have been unremunerative. That was unfortunate, but still not their fault. They had, however, succeeded in getting some work, forming a nucleus, and they believed it would turn out to be satisfactory; they had entered into a contract for lighting the Café Monico, in Regent Street.

Mr. J. L. Hale: Not with your lamp.

The Chairman begged pardon; he would enter into that shortly. They had taken a small building sufficient for their purpose in the neighbourhood where their engines would be erected, and where the power would be generated. Very nearly adjoining that building were other buildings; public places of resort and amusement—the St. James's Hall, the Pavilion, &c., and in the immediate neighbourhood large and fashionable shops—and they believed they could extend their operations to all these buildings, and had been in communication with those in charge with that object. The contract they had was self-supporting, and if from the same centre they could light buildings of much greater magnitude than the Café Monico, they had no doubt they should be able to do it at a satisfactory profit. Replying to the remarks of Mr. Hale, the arc lamp they used was their own; the incandescent lamp they used was not; they had not got an incandescent lamp. They did intend to use the Brush incandescent lamp, but not to confine themselves to it if they could do better for those who used their property and the shareholders. Therefore they were not using the Brush lamp, but another one. They expected to have had that installation at work before that meeting was held, but little difficulties had arisen which had prevented its completion. It would, however, be but two, three, or four days before the installation was at work, satisfactorily he believed, and they could then inspect for themselves the quality of the lamp. He trusted they would find it satisfactory. After that they should very likely have to call them together again, because their funds were pretty well exhausted; and to extend their operations they should require more money. He moved that the report and accounts, be adopted.

Mr. B. Moore seconded.

Mr. Hale pointed out that in their report the directors said they had, by means of experiments, perfected the company's arc lamp. That did not agree with their description of it in the prospectus; in it they made it perfect. Another reckless statement in the prospectus was about the relative cost of the Gramme and Brush dynamos. He had gone into the matter with scientific experts, and he found their Gramme machine was no cheaper than the Brush. He had gone over the factory in Denman Street, adjoining the café "Monico," and was very much surprised at what he saw there; and let them recollect that all the premises and all the plant and machinery they had in the world was that, and in that one place in Denman Street. That so-called factory was a room of only about 20 ft. by 30 ft., and it was quite filled up with one engine and dynamos necessary to light the café "Monico;" but the most astounding thing connected with that café "Monico" was that it was not going to use their lamp at all—it was going to adopt the Edison lamp. The directors had absolutely nothing to show the shareholders for the £29,000 they had subscribed. That money was all gone, as the balance-sheet shewed, and for bringing about the disaster the directors charged them in fees £2,100.

Col. Jones and Dr. Weaver also made a few remarks, both characterising the report and accounts as most unsatisfactory.

The Chairman, in reply said, to some of the questions put, he thought he could give a satisfactory reply, but to others he might not be able to reply so satisfactorily as they could wish. No electric company that he was aware of was in a much better position than they. In answer to Mr. Hale, he did not think the word "perfect" was used in regard to the lamp, but at any rate he should hesitate to say that anything in this world was perfect. Mr. Hale then referred to the cost of the dynamo. The information the directors gave was correct. The Brush Company might have reduced the price of their dynamos, but these prices were taken from the official price-lists issued by the two companies. From the Café Monico they were to get some £700 a year for the installation, and he maintained that it would be a profitable transaction.

A Shareholder asked if the directors considered they had a right to go on with only one-third of the capital they asked to be subscribed.

The Chairman replied that they took legal advice in the matter, and they had a right to.

The Shareholder: Morally had you?

The Chairman said morally they had, for the reason that the shareholders subscribed their money to get a profit. He did say and thought if the directors saw a reasonable chance of their making a profit for the shareholders they were justified in going on. They relied to a considerable extent on the concessions which they had for sale.

A Shareholder: They were bogus.

The Chairman said if they thought three or four large firms of solicitors in London were people to make bogus applications they were much deceived.

A long desultory discussion followed, in the course of which

The Chairman explained that the qualification of each director, as settled by the Articles of Association, was £100. He himself held £100 in shares in the company. All the directors had paid up their shares in full except Mr. Hubback, who, as he had before said, was lying dangerously ill. The directors had drawn £1,400 in salaries. Of the company's money he had had £140, and he certainly felt he had earned it. The directors would agree not to draw the £920 standing to their credit as salaries without the knowledge of the shareholders.

Dr. Weaver asked if there was any reasonable prospect of making money out of the concern. If not, why not wind the company up and be done with it.

The Chairman said the whole matter was in the hands of the shareholders, but he might say if the defaulting shareholders paid up their calls they could complete the work they had in hand, and extend their business to a considerable degree; if they did not pay up they would have to fall back on Dr. Weaver's suggestion.

A shareholder asserted that although all the calls were paid up they would not have sufficient to meet their liabilities.

The Chairman: All our liabilities at the present moment amount to only about £300.

It was then agreed *nem. con.* that the report and accounts of the directors be not adopted, and that the meeting be adjourned for three months in order to ascertain the outcome of the work the company now has in hand.

The Great Western Electric Light and Power Company (Limited and Reduced).

THE first annual ordinary general meeting of the shareholders will be held at Cannon Street, on Monday, when the following report of the directors will be submitted:—

This company was formed in April, 1882, to acquire from the Anglo-American Brush Electric Light Corporation a concession for the use of their Brush patents in the western counties of England and the southern counties of Wales. A license to use the Lane-Fox Incandescent Lamp was also granted over the same area. Shortly after the formation of the company a similar concession for the county of Cardigan was purchased for £1,000 in cash. In June, 1882, the company sold its concession and license for Devon and Cornwall to the Devon and Cornwall Electric Light and Power Company, for a sum of £7,500 in cash, and £7,500 in fully paid shares. Owing to various causes the Devon and Cornwall company is now in liquidation, and under the terms of the agreement, the concession and license for Devon and Cornwall revert to this company, which is now taking steps to work this portion of its district. The past year has been one of considerable difficulty; begun with a wild enthusiasm for the new light, and now followed by an equally unreasonable depression. When the depression took place in the autumn of last year, some of your fellow shareholders sought to escape from the liability they had voluntarily taken upon themselves, alleging a mis-statement in the prospectus in respect to the Lane-Fox Patents. Several actions were brought against the company, and these have resulted in the surrender of 941 shares, at a cost to the company of £274 5s. 3d. All claims on this head are now disposed of, and the time is long passed when any further claims can be maintained. Your present Board, in thanking you for your support at the poll in May last, when the numbers were, for the present Board, 2,120 votes, for the late Board, 1,035 votes, have to report that since their election they have used every effort to place the company on a sound commercial basis, and to develop a profitable business. With this view, the general expenses have been reduced to the utmost, and the lighting stations at Bristol and Cardiff have been developed to a considerable extent, the gross receipts being now as follows:—Bristol, rentals (annual contracts), £350 rentals (lights supplied by the hour), £145; total £945. Cardiff, rentals (annual contracts), £491; rentals (lights supplied by the hour), £50; total £541; total, Bristol and Cardiff, £1,036. Your

directors have entered into an arrangement with the Electrical Power Storage Company for the supply of the Faure Sellon-Volckmar accumulators, thus completing their stock of electric appliances, and enabling them to undertake lighting of every kind and also to supply motive power. The late Board had gone to some expense with a view to obtaining provisional orders for Bristol, Cardiff, and other towns under the Electric Lighting Act, but on taking office your directors, in fulfilment of their promise to the shareholders, decided to drop them for the present. The Corporation of Bristol are obtaining an order themselves, and your company is now in a position, if required, to supply them with all the needful plant to carry it out. In Cardiff your company is at present free from rivalry, and owing to the cheap rate at which electricity can be supplied on the Brush system is likely to continue so. There are signs of an improved demand for electric lighting this autumn, and your directors believe that by next summer the trading operations of the company will show a fair margin of profit. With a view to any such profit being available for dividend purposes, your directors recommend that the whole of the extraordinary expenses incurred during the past year for organising the company, and in connection with the alleged error in the prospectus should be written off. Your directors have taken all necessary steps to make your shares fully paid up; but pending the withdrawal of certain claims made by the liquidators of the Devon and Cornwall company the matter is in abeyance. An action has been commenced by one of the Devon and Cornwall company's shareholders, in which your company are made co-defendants with the directors, promoters, and solicitor of that company. Your directors will take all necessary steps to protect your interests. The liquidation of the Devon and Cornwall company has not made sufficient progress to enable the probable return to be estimated, and no value has therefore been placed upon the shares you hold in the company. With a view to the thorough working of your district, agents are being appointed in various counties and towns, who by their local knowledge and influence will doubtless secure a large proportion of the electric lighting offering. The result of the fourteen months working has been a gross profit of £1,706 1s. 8d., which is turned into an actual loss of £3,801 13s. 9d., chiefly owing to the heavy expenditure in fees, travelling expenses, and general charges incurred by the late directors. Taking into account the cash received from the Devon and Cornwall company, the fourteen months' working show a profit of £112 14s. 6d., after writing off the whole of the preliminary expenses, the extraordinary law charges, the cost of 500 Devon and Cornwall shares, and 10 per cent. depreciation on the plant in use at your lighting stations. This balance it is proposed to carry forward to next year. With a sufficient capital in hand, active and loyal officers, and the best system of electric lighting and storage of electricity, your directors look forward hopefully to the result of their efforts during the next twelve months.

The Gulcher Electric Light and Power Company, Limited.

THERE was a lengthy meeting of the above company, held on Tuesday last, but as our reporter was refused admittance, we are unable to say what took place thereat. In connection with this matter we think it a duty to mention an exceptional circumstance which has arisen. On applying to the secretary for a copy of the report, we were denied this small courtesy. Seeing that we have never spoken of the company's business operations previously in any way, nor of its apparatus otherwise than favourably, we do not find it difficult to assign a reason for this unusual treatment, but having drawn attention to the fact, we prefer to leave our readers to form their own opinions of this very childish and futile policy. The report, which we obtained from a shareholder, is dated August 16th last, and runs as follows :—

The company was established in May of last year, and the accounts are made up to the 30th of June of the present year. The expenditure under the head of capital account amounts to a much larger sum than the directors originally contemplated investing in plant and works. It was at first decided, in order to avoid the expense of erecting workshops and the purchase of machinery, to entrust the manufacture of electrical plant to a firm of engineers, and with this view an agreement was entered into with Messrs. Ransome, Josselyn, & Woods; but, as has been already notified to the shareholders by a previous circular, it was found necessary to terminate this arrangement, and for the company to take over the works from Messrs. Ransome, Josselyn, & Woods, and to have complete control of the manufacture under the immediate supervision of their electrician and a works manager. The amount paid to Messrs. Ransome, Josselyn, & Woods for plant and machinery, is the exact amount expended by them, and before concluding the purchase the directors took the opinion of Mr. Ewing Matheson, M. Inst. C.E., a well-known engineer, as to whether the money had been judiciously expended by Messrs. Ransome, Josselyn, & Woods; his report, upon which the directors acted, will be before the meeting. As the agreement with Messrs. Ransome, Josselyn, & Woods was to be of five years duration, they have required some consideration for cancelling it at the end of the first year, and as it was not convenient for the company to pay down a lump sum, it was agreed that they should receive a small royalty on the net manufacturing receipts during the time their original contract would have lasted. Another large item of expenditure not contemplated when the company was first established to work Mr. Gülcher's patents, has been the purchase of the incandescent lamp patents from Mr. Wm. Crookes, F.R.S., a purchase which promises to bear very beneficial results to the company. The working account is considered by the directors as, on the whole, not unsatisafctory, when it is borne in mind that we have passed through a year of great reaction and depression in electric lighting, and also that a considerable portion of it as regards this company was necessarily taken up in preliminary preparations for carrying out the manufacture of plant on a sufficient scale. The amount spent in exhibitions is somewhat heavy, but the directors looked upon this as the best form of advertisement, and, considering that they had to bring before the public an entirely new system, they thought they were warranted in incurring the expenditure, and are satisfied with the results of their exhibits from the orders since received.

The balance-sheet shows a deficiency of £18,678 8s. 8d. This sum includes £1,787 17s. 11d. manufacturing commission paid to Messrs. Ransome, Josselyn & Woods for work done by them; and in addition to a very liberal allowance for depreciation on plant of every kind, a sum of £6,500 which the directors have been advised that it is prudent to write off as depreciation of patents, owing to one year of their term having expired. A very considerable proportion of the remaining deficiency has been really expenditure on exhibitions, and improvements and development of the patents, which have been carried out by the advice and under the direct supervision of the patentee (Mr. Gülcher), with the effect that the dynamo machines and lamps of this company have kept pace with the rapid strides made in the progress of electric lighting during the past year, and stand well to the front in point of efficiency and economy.

The works are now entirely under the management of the company, and are in a state of great efficiency, and capable of producing an output that would yield a profit of £16,000 per annum, equal to a dividend of about 10 per cent. on the present paid-up capital. The company has secured the services of an efficient electrical and mechanical staff, and possesses a valuable stock, comprising a large supply of dynamo machines, arc and incandescent lamps, conducting wires and other appliances for erecting installations. Owing to the time taken up in organising the factory and other preliminary work already alluded to, the company was not prepared to undertake business of any importance last winter, so that the lighting season of last year was practically lost to them; this will account for the small amount of business actually done. The prospects for this winter are more satisfactory, and several very important contracts are being negotiated for; amongst others, the lighting of a section of the City has been applied for, and the company has reason to believe that its offer is being favourably entertained. Shipments of electrical plant have recently been made to Australia, where influential agents have been appointed, and installations have been exported to India and Canada. Messrs. Miles Brothers & Co., the company's agents in New Zealand, are doing a promising business, and taking monthly supplies of plant; they speak very favourably of the prospects of business in their colony. The directors regret that their efforts to establish subsidiary companies, which have entailed heavy expenses, have not borne fruit, and they attribute this to the depression which has hung over electric lighting generally during the past twelvemonth, and the reaction following upon the excessive speculations in these investments. In default of being able to dispose of their patent rights throughout the kingdom, the directors have commenced to organise a regular system of agencies in all the important towns and districts to promote the extension of business in the future. The present directors retire in accordance with article 69, and the following offer themselves for re-election—Major-General Bogle, and Messrs. Gilman, Norton, and Pledger. The auditors, Messrs. Wm. Edwards, Jackson & Browning, and Messrs. Leslie, Kirby, Straith & Co., retire, and they seek re-election.

The BALANCE-SHEET gives the following figures :—

Liabilities.—Capital issued and paid up, £168,517 10s.; less calls in arrear due, £15,091 18s. 4d.; total paid up, £153,425 11s. 8d.; to creditors for purchase money of patents, bills payable, loans and interest, trade and other debts, £19,313 0s. 10d.; total, £172,738 12s. 6d. Assets.—By purchase of patents, less deposit on concession sold, £1,000 (purchase not completed), and amount written off, 14 months, £6,500—£128,773 1s. 3d.; plant, machinery, tools, and office furniture (less depreciation), £7,830 7s.; proportions of outlay carried forward (exhibitions 50 per cent., law charges, and establishment expenses), £1,489 15s. 10d.; trade debtors, £1,106 13s. 5d.; cash at bankers and in hand, £2,560 6s. 4d.; stock, as per valuation, £12,300; balance, being deficiency on working for 14 months, brought from profit and loss account, £18,678 8s. 8d.; total, £172,738 12s. 6d.

The St. George Telephone Company (Limited).—The directors are now prepared to allot preference shares of £5 each, entitled to preferential dividend of 7 per cent. per annum, payable £1 on application and £1 on allotment, and the balance as required at intervals of not less than two months. The company has removed its offices to 20, Bucklersbury, E.C.

The West Coast of America Telegraph Company (Limited).—This company notifies the reduction of tariff *vid* Galveston (United States) to Valparaiso, Santiago, Coquimbo, Serena, Caldera, and all stations in Chili, to 10s. 8d. per word; also that the rate for messages *vid* Galveston to Buenos Ayres and all stations in the Argentine Republic, has been reduced to 10s. per word.

The Direct Spanish Telegraph Company (Limited). This company's direct cable communication with Spain, *vid* Bilbao, is again fully restored.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, Aug. 22.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	7	2¾-3¼	2¾*m.*-3-2⅝*a.*
		Do. Do.	10	6 - 6¼	
20,000	5	Australasian E. L., Power & Storage Co.	3	½ - ¾	
24,000	10	British Insulite Co., Ld., "A" Shares..	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	¼ - ⅜	
25,000	5	Gt. Western Electric Light & Power Co.	2½	¼ - ⅜	
24,980	5	Hammond Elec. Lt, & Power Sply. Co.	2½	¾ - 1¼	1*a.*
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
172,500	1	Maxim-Weston Elec. Lt. & Power Co. ..	1	7/16 - 9/16	
..	..	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2	..	
..	..	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.....	2½	1¾ - 2	
		TELEGRAPHS.			
2,116,400/.	Stk.	Anglo-American, Limited	100	47½ - 48½	80*a.*
2,441,800/	Stk.	Do. Pref. { Def. receiving no div. until	100	79½ - 80½	
2,441,800/	Stk.	Do. Def. { 6 p. c. paid to Pref.....	100	17 - 18	17*a.*
130,000	10	Brazilian Submarine, Limited	10	11¾ - 12	
16,000	10	Cuba, Limited	10	11 - 11½	
6,000	10	Do. 10 per cent. Preference ..	10	17½ - 18½	
13,000	10	Direct Spanish, Limited	9	5 - 5½	
6,000	10	Do. 10 per cent. Preference ..	10	15½ - 16½	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	12½ - 13½	12 11/16*m.*-12 13/16*a.* / 13-12⅝*a.*
100,000/.	100	Do. 6 per cent. Deb., repayable 1884	100	101 -103	
380,000	10	Eastern, Limited	10	10⅝ - 10¾	10 13/16*m.*-10⅝*a.*
70,000	10	Do. 6 per cent. Preference.....	10	12½ - 13	12⅝*m.*-12¾*a.*
232,000/.	100	Do. 6 do. Debs., repayable Oct. 1883	100	100-102	
200,000/.	100	Do. 5 do. do. Aug. 1887	100	100-103	
200,000/.	100	Do. 5 do. do. Aug. 1899	100	103-107	
199,750	10	Eastern Exten., Australasia & China, L.	10	11¼-11⅝	11 5/16*m.*-11 5/16*a.*
320,000	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	106- 109	
500,000	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102- 106	
140,000	100	Do. do. reg., repayable 1900..	100	102- 106	
100,000/.	100	Do. 5 per cent. Debenture, 1890	100	102- 105	
254,300/.	100	{ Eastern & South African, Ld., 5 p. c. { Mort. Deb. Rg. redeemable 1 Jan. 1900 {	100	102- 105	
345,700/.	100	Do. do. do. To Bearer..	100	101 - 104	
22,050	10	German Union Telegraph & Trust, Ld.	10	9¾ - 10¼	
163,380	10	Globe Telegraph & Trust, Ld.	10	7⅛ - 7¾	7⅛*m.*-7 7/16-5/16*a.*
163,380	10	Do. 6 per cent. Preference	10	12⅛ - 12⅝	12⅛*m.*-12¼*a.*
125,000	10	Great Northern	10	12½ - 13	12⅝*m.*
100,000/.	100	Do. 5 per cent. Debentures ..	100	100 -102	
200,000	100	Do. 5 per cent. Debentures ..	100	101 -104	103*a.*
31,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	28 - 29	
100,000	100	Do. 6 per cent. Debs., 1886	100	103-106	
17,000	25	Indo-European, Limited	25	31 - 32	
38,148	10	London Platino-Brazilian, Limited	10	3¾ - 4	
12,000	10	Mediterranean Extension, Limited	10	1¾ - 2	
8,200	10	Do. 8 per cent. Preference	10	2 - 4	
9,000	8	Reuter's, Limited	8	8½ - 9	
280,000	Stk.	Submarine	100	220 -230	
58,225	1	Do. Scrip	1	2 - 2½	
4,200	Cert.	Submarine Cables Trust	100	103 -107	
37,350	12	Telegraph Construction and Mainten.	12	33 - 34	33¼*a.*
150,000	100	Do. 6 per cent. Bonds, 1884 ..	100	98 -101	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅛ - 1⅞	
30,000	10	West Coast of America, Limited	10	4⅞ - 5⅛	
150,000	100	Do. 8 per cent. Debs.	100	104 -107	
69,910	20	Western and Brazilian, Limited	15	5⅝ - 6¼	
		Do. Preferred	7½	4⅞ - 5⅛	
		Do. Deferred	7½	1 - 1½	
200,000/.	100	Do. 6 p. c.. Debs. "A" 1910	100	102 -106	
2,500	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	95 - 98	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	122 -124	122*m.*
1,030,000/.	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,321	10	West India and Panama, Limited	10	¾ - 1	
34,563	10	Do. 6 per cent. 1st Preference	10	6½ - 6⅞	
4,669	10	Do. 6 do. 2nd do. ..	10	5 - 5½	
		TELEPHONES.			
154,165	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	¼ - ½	
200,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	½	¼ - ⅜	
100,000	5	United Telephone Co.	5	8 - 8½	8¼*a.*

NEW PATENTS—1883.

3886. "Storage or secondary batteries." A. J. JARMAN. Dated August 10.

3901. "An improved construction or arrangement of electric switch or apparatus for making and breaking contacts." J. LEA. Dated August 11.

3910. "Incandescent electric lamps." A. SWAN. Dated August 13.

3915. "Incandescent electric lamps." G. F. REDFERN. (Communicated by A. Bernstein.) Dated August 13.

3917. "Galvanic batteries." H. J. ALLISON. (Communicated by A. Haid.) Dated August 13.

3934. "Dynamo electric machines." W. P. THOMPSON. (Communicated by R. J. Sheehy.) Dated August 14.

3946. "Generating and utilising electric currents." P. HIGGS. Dated August 14.

3963. "Working telephones." F. MORRISS. Dated August 15.

3967. "Insulating supports for telegraph and telephone wires." S. WOOLF. Dated August 15.

3970. "Construction of lead plates for the storage of electrochemical force in accumulators." A. C. HENDERSON. (Communicated by G. Philippart.) Dated August 16.

4003. "Telephonic apparatus." G. H. BASSANO, A. E. SLATER, F. T. HOLLINS. Dated August 17.

4037. "Electric secondary or storage batteries." R. H. COURTENAY. Dated August 21.

4038. "Cells of voltaic batteries." R. H. COURTENAY. Dated August 21.

4059. "Galvanic batteries." G. C. V. HOLMES, S. H. EMMENS. Dated August 21.

4061. "Manufacture of commercial products resulting from the operation of galvanic batteries." G. C. V. HOLMES, S. H. EMMENS. Dated August 21.

4071. "Galvanic batteries." O. C. D. ROSS. Dated August 22.

4104. "Appliances for hanging electrical lamps." T. T. SMITH. Dated August 24.

4110. "A new electro-telegraphic system particularly applicable for long cables." A. GUATTARI. Dated August 24.

4136. "Electric railways and locomotives or engines used with the same." S. PITT. (Communicated by L. Daft.) *Complete.* Dated August 28.

4137. "Electric railways and locomotives or engines used with the same." S. PITT. (Communicated by L. Daft.) *Complete.* Dated August 28.

4148. "Electrolytic treatment of saccharine solutions." L. H. DESPEISSIS. Dated August 28.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

6019. "Dynamo-electric machines." WILLIAM SMITH HOBBY. Dated December 16. 6d. This invention relates to improvements in dynamo electric machines, pear, or oval, or oblong-shaped coils of iron, copper, or other good conducting wire, square rod, or strip of narrow size or width, are built up into a wheel shape. In as close contiguity as possible to the above referred to coils or segments, are a series of electro magnets, the iron cores of which may form part of the frame of the machine, being cast with it, or may be of wrought iron and be bolted or rivetted to it. These electro magnets are so wound as to present alternate N and S poles to the armature, consisting of the pear-shaped coils before referred to, as it turns between them, so that a current taken off from such armature would be alternating. The field or inducing magnets can be excited separately, or a portion or the whole current the

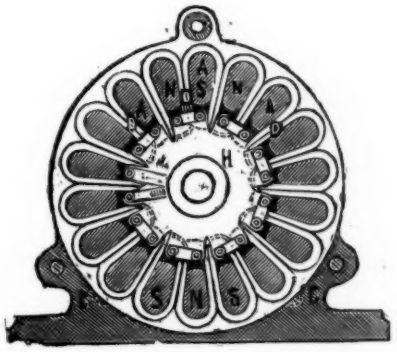


FIG. 1.

machine is capable of producing may be used for this purpose, a commutator being employed to convert the alternate currents into currents of one direction. Since, however, an alternating

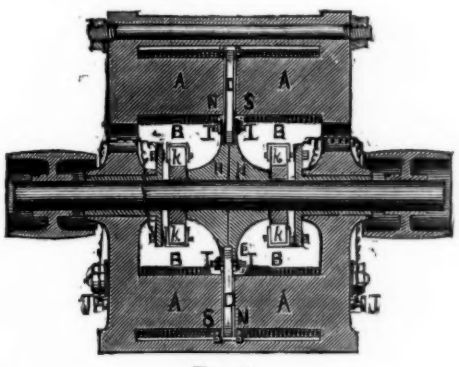


FIG. 2.

current is in some cases preferable, while a separate exciter would be inconvenient, the inventor uses, attached to the same spindle carrying the armature, a separate armature of similar kind, or it may consist of wire coils or plain copper bars, this is mounted for

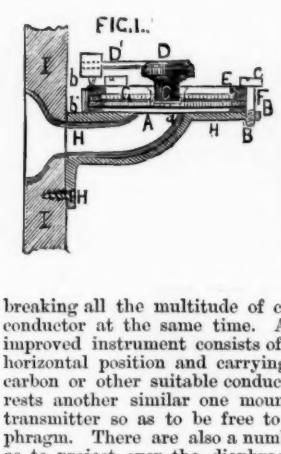
convenience outside the frame, and the cores of the electro-magnets are either continued through the casting to the outside, or bosses are cast upon the outside of the frame and wound with wire of suitable size. The second armature is excited by these bobbins or exciting field-magnets, and has for its external circuit the field-magnets on the inside of the plates which excite the internal and main armature, the current being of course collected by a commutator, and direct. Figs. 1 and 2 shew sectional and side views of the improved dynamo machine; A A A are the electro-magnets, which in this case are cast in one piece with the side frame. These electro-magnets are wound with copper wire or strip, shown at B B, the ends of which are brought down to the terminals shown at C. Each electro-magnet is wound in such a manner as to present alternate N and S poles to the armature, D, composed of the pear, oval or oblong coils described, as it turns between them. The armature, D, is composed of copper wire or strip, perfectly insulated between each layer, and the induced current traverses the wire or strip. The armature is held in position by means of the boss or cheek plates, H H. Insulated bolts are passed through the ring of the boss or cheek plates, and so holding the segments of the armature, the bolts serving to connect or make the circuit between segment and segment by means of the links, E E. The outer strip or wire being connected by rivetting or soldering, thus making the armature one continuous conductor. In the alternating current machine the brushes, K, are shown attached to, but insulated from a metal sleeve, which forms the bush for the spindle, wires being led from each brush to the terminals, J J.

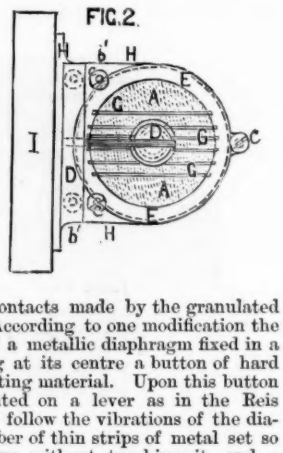
6002. "Apparatus for generating and distributing electric currents for lighting interiors." ALEXANDER MELVILLE CLARK. (Communicated from abroad by Gustave Trouvé of Paris, France.) Dated December 15. 6d. Relates chiefly to the battery described in the ELECTRICAL REVIEW for April 28th, 1883.

6003. "Electrical conductors, couplings, switches and terminal connections." STEPHEN HENRY EMMENS. Dated December 15. 2d. This invention has reference to an improved method of arranging and constructing the various parts of an electric circuit, so as to ensure better contacts and insulation, greater safety against fire, and quicker and more artistic laying of wires. (*Provisional only.*)

6004. "Attaching electric lamps to fittings or supports." STEPHEN HENRY EMMENS and ROLAND ISAAC BARNES. Dated December 15. 2d. This invention relates to improvements in the means of attachment of electric lamps to brackets, chandeliers or other fittings, and it is designed mainly to utilise the globes of gas fittings as supports, so as to admit of the easy substitution of electric lamps without disturbing the gas supply. (*Provisional only.*)

6020. "Telephonic apparatus." GEORGE LEE ANDERS and JOHN BENJAMIN HENCK. Dated December 16th, 6d. This invention relates especially to instruments for use in connection with static receiving telephones, such as are described in the specification to letters patent granted to William Robert Lake, dated March 29, 1881, No. 1395, but it is equally applicable to other forms of static receivers, and partly also to other electric telephones. The invention consists partly in certain improved forms of transmitting instruments, and these, although especially adapted for use with static receivers, are also applicable to other forms of electric telephones. The objects of this part of the invention are to produce a transmitting instrument of low resistance, and at the same time not subject to the fault of too easily breaking the circuit, and these objects are accomplished by combining microphonic instruments on the same general plan as that which is commonly known as the Reis transmitter with less sensitive arrangements, in which granulated conducting material is the active element. The harshness due to breaking contact in the microphonic part is thus avoided by the impossibility of





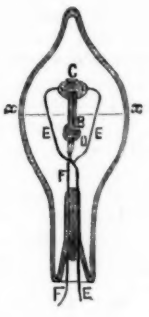
breaking all the multitude of contacts made by the granulated conductor at the same time. According to one modification the improved instrument consists of a metallic diaphragm fixed in a horizontal position and carrying at its centre a button of hard carbon or other suitable conducting material. Upon this button rests another similar one mounted on a lever as in the Reis transmitter so as to be free to follow the vibrations of the diaphragm. There are also a number of thin strips of metal set so as to project over the diaphragm without touching it, and a quantity of granulated coke, or other suitable conducting material in a granulated form, is placed upon the diaphragm so as to come in contact with the metal strips. The latter are in metallic connection with the upper button. The instrument is fitted with a mouth piece so arranged as to direct the sound waves upwards against the diaphragm. This modification of the said invention is illustrated in figs. 1 and 2, which represent respectively a vertical section and a plan of a transmitter constructed in accordance therewith. A is a metallic diaphragm, fixed in a horizontal position between two rings, B, B^1, of cork or other suitable material, and carrying at its centre, by the intervention of a metal cup, *a*, a button, C, of hard carbon, or other suitable conducting material. Upon this button rests another similar one, D, mounted on a lever, D^1, and fulcrum pins, *b*, which latter enter mercury cups, b^1, carried by a casting H. E is a ring, which rests on a packing ring, F, bearing on the cork ring, B, and carries a number of thin metal strips, G, projecting over the diaphragm without touching it. A quantity of granulated coke, or other suitable conducting material in a granulated form is placed over the the diaphragm, A, as shown, so as to come in contact with the metal strips, G, G, which are in electrical connection with the upper button, D, forming one terminal, whilst the other terminal is carried by the diaphragm. The several rings gripping the diaphragm are secured by screws, *c*, to the casting, H, attached to a board, I, and forming therewith the mouth-piece which is so arranged as to direct the sound waves upwards against the diaphragm. They also before using the instrument pass an intermittent battery current through the primary wire of the induction coil (the receiver or receivers being always connected to the secondary wire) for the purpose of giving to the receiver or receivers an initial charge, which is found to increase their sensitiveness and therefore the loudness of the sounds emitted. A compound key is provided so that this charging is accomplished by the same movement, which serves also to pass a signalling current to the distant station. The current passing to the distant station may be the same which passes through the primary wire, or there may be two independent currents passed by simultaneously closing the circuits of two independent batteries.

6023. "Telephonic apparatus." WILLIAM ROBERT LAKE. (A communication from abroad by George Meelin Torrence, of Philadelphia, Pennsylvania, United States of America.) Dated December 16. 6d. This invention relates to telephonic apparatus, and comprises a transmitter and a receiver both of novel construction. With respect to the transmitter the said invention consists mainly in supporting one of the electrodes of a microphone in contact with the other electrode by the attraction or repulsion existing between permanent magnets. This is done by freely pivotting and suspending at the upper end a bar magnet, or a bar of any material the free end of which is made susceptible of magnetic influence by attaching thereto a magnet or magnetic material. Or the magnet or bar may be supported by resting its lower end on a base for the purpose of holding said magnet or bar in front of the electrode attached to a diaphragm. So that an electrode attached to the magnet or bar will, when in proper position, make contact with the electrode attached to the diaphragm. The magnet or bar is held in working position by the attraction or repulsion exerted on its free end by permanent magnets or magnetic material placed radially about its free end. Or the magnet may be held in its working position and contact of the electrodes regulated by attraction of said magnet for an armature of steel or iron secured to the frame and adjusted by a suitable screw. It is obvious that if the free end of the bar is terminated with an armature only there must be magnets to hold it in adjustment, while if the bar is terminated with a magnet, or is itself a magnet, it may be retained in its working position by the attraction or repulsion of other magnets or pieces of magnetic material placed radially about its free end.

The inventor also constructs, according to this invention, a telephonic receiver in which the sound is sharp, distinct, or well defined, without the ringing and singing so often accompanying telephonic receivers. For this purpose he provides an annular magnet which is divided, and one end is turned inwardly and then outwardly at the centre, forming a secondary pole upon which a spool is fitted, the split or divided magnet forming the poles on the upper and outer ends.

6075. "Incandescent electric lamps." LORENTZ ALBERT GROTH, K.G.N. (A communication from abroad by Alex Bernstein, of Boston, in the county of Suffolk and state of Massachusetts, United States of America.) Dated December 20. 6d. This invention relates to improvements in incandescent electric lamps, and has for its object the construction of an incandescent electric lamp which will be more durable than those heretofore in use and more economical in the production of light, by rendering the light giving carbon capable of withstanding the action of strong currents, so as to avoid the disintegration which gradually takes place in carbon filaments of high resistance. In order to obtain this desired effect, the inventor makes use of a hollow carbon cylinder as the light giving part of the lamp, thereby obtaining a large light giving surface, in proportion to a cross section of the carbon and a large volume of light. The invention consists of an incandescent electric lamp, in which the light giving carbon is made of a hollow cylindrical carbon or carbons, which are supported by socket pieces of solid carbon. One of the conducting wires is rigidly applied to one of the carbon socket pieces of the light giving part, while the other conducting wire is made flexible, so as to provide for expansion or contraction of the light giving carbon, and admit the use of strong currents without detriment to the lamp. The lamp, as well as the hollow light giving carbons in the lamps, may be arranged in different combinations, so that stronger outdoor lights and small lights for indoor use may be conveniently arranged in the same electric lighting

circuit. In the accompanying drawing, which fully illustrates the invention, the figure represents a vertical central section of the improved incandescent lamp. In the interior of the glass globe is arranged the light giving carbon, B, which is made of a hollow cylinder, and supported at the ends by the socket pieces or blocks of solid carbon, C and D. The light giving carbon B, as well as the conducting wires, E and F, are secured to the carbon socket pieces, C and D, by means of suitable carbonaceous cement. The conducting wires, E and F, enter the globe either at one end



through the neck of the same, as shewn, or at the opposite ends of the globe. One of the conducting wires, E, is made rigid, while the other conducting wire, F, is made flexible by being composed of a large number of thin wires. This is the essential feature, which appears in every form of the improved lamp, as thereby the light giving carbon is enabled to expand and contract without being liable to injury and breakage, so that a current of considerably greater strength can be used without endangering the lamp than with incandescent lamps having carbon filaments of high resistance. One or more light giving carbons, B, may be employed in the same lamp, and different dispositions of the same be made.

6083. "Electro-motors." LEONARD MILNE and LESLIE BRADLEY MILLER. Dated December 20. 6d. This invention relates to electro-motors or machines for generating electricity whereby is obtained efficiency combined with simplicity in construction. In the invention the armature consists of two coils of wire wound longitudinally on a X shaped frame of iron, brass, or other material, at right angles to each other. Or the inventors wind

FIG. 1.

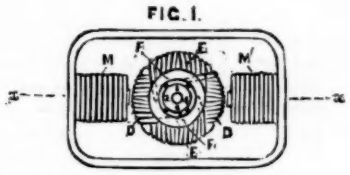
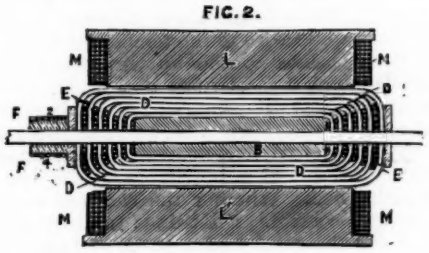


FIG. 2.



the two coils on an iron core, with projections to separate them. The commutator is divided into four sections, and the ends of each coil are brought to sections diametrically opposite. By this means each of the coils is brought into action in turn when approaching the most advantageous position in the magnetic field, and cut out to be replaced by the other when receding from it. They also make use of two small springs on the commutator, or other simple device, by which, if desired, the sections may be connected in pairs, and both coils brought into action at once. With this armature the inventors prefer to use field magnets, with narrow pole pieces, with the object of concentrating the magnetic field on the coil which is in action. The armature of the improved electro-motor is composed of a cross-shaped frame or core of iron, or other suitable material, upon which are wound two independent coils, D, E, at right angles to each other, as shewn. The two ends of the wire forming the armature coil, D, are joined to the two diametrically opposite sections, 1 and 3 of the commutator F, and the two ends of the coil, E, to the commutator sections 2 and 4, as shewn. It will be thus readily seen that each coil, with its commutator sections, is independent, so that they are not in circuit at the same time. The armature frame, B, is hollowed out at its ends, in order that the thickness of the two coils, D and E, which cross each other at the ends of the said frame, may not cause the wire to project much beyond the end projections of the frame. The inventors prefer to wind the two coils so that they may lie in alternate layers at the ends of the frame, as shewn in fig. 2, where the coil, E, is shewn in section by the small circles. The commutator brushes are arranged parallel to each other, and supported by a journal bracket, or in any other suitable manner. For the purpose of concentrating the magnetic field upon the armature coil in circuit for the time being, they may employ a field magnet, having two separate narrow internal projections, L, L^1, forming the poles, on which the field magnets, M, M^1, are placed. By this form of construction they obtain the concentrated magnetic field desired for the purpose hereinbefore mentioned.

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CORRESPONDENCE.

The Hammer Telephone of M. De Locht-Labye.

Since M. De Locht-Labye has so courteously thrown down the gauntlet, perhaps he will kindly explain the following:—

(1.) What constitutes a flexible organ?

(2.) Under what conditions are wood, glass, or ebonite unsusceptible of undulatory movements, as these substances under ordinary circumstances possess the two essential properties for the propagation of sound, viz., elasticity and density?

(3.) Assuming D to be thick, rigid, inflexible, and unsusceptible of undulatory movement, by what process are the impulses, or, as M. De Locht-Labye puts it, sudden shocks, conveyed to the lever, L, when the instrument is used as a transmitter?

(4.) Supposing L to have received a given number of shocks of a certain intensity, say a musical note produced by the human voice, how does it, "the lever," discriminate between this and the same note of equal intensity, sounded on a violin; in other words, how is the *timbre* transmitted?

(5.) Since all the movements are sudden and in no way possess a duration equal to that of a sound-wave of air, how is the sound-wave reproduced at the receiving end?

In raising the above queries, I do not wish in any way to disparage the telephone, on the other hand, I

have no doubt in my own mind that it will accomplish all that is claimed for it, and should be very pleased to hear of its being in the market.

Trusting M. De Locht-Labye will not deem my questions too impertinent.

F. W. Cooke.

Telegraph Department,
G. N. Ry., Retford.

A Rotten Telegraph Pole.

In the last number of the journal you inserted under the heading of "A Rotten Telegraph Pole," a paragraph giving information regarding the unfortunate accident that occurred at Garngad to "Benjamin Wyllie," one of my workmen. Whoever has supplied the information is ignorant of the facts, both in regard to the employment of the man and of the manner in which the accident happened. The pole was quite sound and did not snap as stated. I would therefore beg to ask you to insert a correction of the paragraph, which gives a very wrong impression as well as reflects seriously upon myself, as I have the maintenance of the line upon which the pole in question stands.

The accident occurred through other causes, but which it is unnecessary to detail.

A. F. Clement.

The North British Railway Company,
Telegraph Superintendent's Office,
Edinburgh, 22*nd August*, 1883.

[We have great pleasure in inserting our correspondent's letter. The note referred to was sent to us by one of our country contributors.—EDS. ELEC. REV.]

Telephone Extraordinary.

I beg leave to send you a charming specimen of penny-a-liner work on the telephone. Comments on its beauties, the boundless wealth of the writer's imagination, and "the curious absence of knowledge of the thing itself," would only mar the pleasure derivable from its perusal. It is, however, a little remarkable to learn that 32 miles is the length of the "longest private wire in the world," when you so recently informed your readers that the National Telephone Company had rented from the Post-office a private wire between Edinburgh and Glasgow, a distance of nearly 50 miles. Alongside of this private line *career* messages all day long, but I am assured that, like her Western sister, this line scrupulously attends to her own business and heeds not the *careering* of the telegraphic dispatches. Is it not a pity that some folks could not be worked on the "twist" principle, so that their lucubrations might, like the simplest element of electric science, return to the place whence they originated?

Fareham.

"TELEPHONE EXTRAORDINARY.

"Passengers from Glasgow to Wemyss Bay having good eyesight and fair perception, may make themselves acquainted with the newest feature of telephonic science. Mr. John Burns of Castle-Wemyss has recently had provided for him by the Post-office telephonic communication between his office in Jamaica Street, Glasgow, and his house at Wemyss Bay on the most approved principles. A distance of 32 miles, it is the longest private wire in the world, but the perfection of the work also makes it the most perfect. It is no exaggeration to say that, no matter how many trains may be passing along the railway, and however many telegraphic messages may be careering along the wires on the poles, the Castle-Wemyss private wire keeps itself absolutely free of all of them, and attends to its own business. The arrangements producing this most desirable result may be seen from the windows of the moving train. The Castle-Wemyss private wire is what is known as a metallic circuit—that is to say, it consists of two wires through which the current of electricity passes round and round up one wire and down the other, and always in the same direction. Ordinary telephone and electric wires consist only of one wire, and instead of the return wire there are short wires at each end running to the earth to complete the circuit. One of the simplest elements of electric science assumes that a current always returns to the place where it originated, and in ordinary cases the earth is used as the medium for the return. While this process serves the primary purposes of completing the circuit, it results in several disadvantages, and, amongst others, it conducts on to the wire currents that may be floating about the earth in the neighbourhood of the terminal wires, and these currents will disturb the telegraph or telephone instruments. The double wire avoids this cause of confusion, but it does not prevent the reception of currents or vibrations from neighbouring wires. If the double wire were completely insulated with gutta-percha or some other substance, the wires would not be subject to the reception of electrical vibrations coming from the neighbouring wires. But they are if uncovered and run from post to post in parallel lines. An expedient has, however, been adopted in place of complete insulation that, at least in the case of the Castle-Wemyss wire, answers completely. The two wires are "twisted," as it is called. They are not allowed to touch each other, of course, but they revolve round each other as they are carried from post to post. To understand the process it is necessary to imagine four positions on one of the arms of each of the telelegraphic posts, and these may be indicated by

A B
C D

The up wire we may suppose is suspended on insulator, A, and the down wire on insulator, D, on the first post. On the second post the up wire is fixed to insulator, B, and the down wire on C. At the third post the wires are fixed, the up on D and the down on A. At the fourth post the wires are fixed on B and C, and at the fifth post they assume their original relative position, having made a complete circuit of each other in precisely the same way as two strands of a rope encircle each other, but by the tension with which they are suspended they of course do not touch each other. Having strung the wires in this manner, it will be observed that no other wire on the poles can come near to the up wire without within four poles distance coming within precisely the same relation to the down wire. The result of this arrangement is that induction is prevented, or rather neutralised. Induction consists in the passage through the air of vibrations from an ordinary telegraphic wire to the telephone wire. Now, if a vibration passes to the up wire of the Castle-Wemyss telephone, it is obvious that within four telegraph posts the same vibration will affect in almost an identical manner the down wire, and the two currents will, it appears in practice, neutralise each other, and extinguish the otherwise inevitable confusion. The effect is undoubted. Whether the cause is accurately defined is less certain. All things in electric science are as yet for the most part matters of knowledge of effect, coupled with a curious absence of knowledge of the essence of the thing itself.

"The telephone used at either end—in Jamaica Street, Glasgow, and at Castle-Wemyss—is an ordinary Gower-Bell telephone, supplied by the Post-office. The transmission of sound is perfect, and there is, indeed, less difficulty about hearing through this long distance of 32 miles than there is in many of the short circuits. One curious fact in connection with the use of this telephone illustrates in a remarkable manner its perfection. Although many trains may be passing up and down the line when the telephone is in use, the noise made by them has no effect upon the delicate vibrations passing from voice to ear. On the other hand, a train passing the window of the telephone-room in the Cunard Office, which is in close proximity to the Central Station in Glasgow, is heard distinctly at Wemyss Bay, and puts a stop to conversation for the moment until it has passed, unless the sound caused by the passing train can be shut out from the room where the telephone is placed."—*Glasgow News.*